THE UNIVERSITY OF ALBERTA

AN EXAMINATION OF THE ROLE OF MEMORY PROCESSES IN READING COMPREHENSION

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF ELEMENTARY EDUCATION

EDMONTON, ALBERTA

FALL, 1970

DISSERTATION ABSTRACT

Comprehension of written material is a complex process involving many abilities and skills, only a few of which have been examined. Memory appeared to be one ability which had yet to be explored in relation to reading comprehension. Consequently, it was the purpose of this study to examine the role of memory processes in reading comprehension.

A review of the literature led to the construction of a theoretical framework from which hypotheses were formulated. The theoretical view of memory adopted in this study stressed organization in memory processes. Experimental measures of memory and reading comprehension were devised and administered to a sample of one-hundred-and-fifty grade six students. The results were analyzed statistically for evidence of the role of memory in comprehension. An examination was made of the protocols of selected subjects and of selected responses to the reading tests for insights into the role of memory in comprehension.

The measure of memory utilized involved the free recall of word lists. Three types of word lists were constructed; one type - the Semantically Organized Lists - included words selected according to a semantic criteria, that of conceptual category, while another type - the Linguistically Organized Lists - included words selected according to a linguistic criteria, that of part-of-speech. The third type included words selected at random. All words were chosen from articles selected from children's reading materials.

The measure of reading comprehension used was the cloze procedure, as it has been found to be both valid and reliable and to measure literal comprehension. Cloze tests involving the deletion of every

fifth word were constructed for the same three articles from which the free recall lists had been selected. Standardized tests of reading achievement and mental maturity were also administered.

The data collected were analyzed by means of the computation of correlations, Z tests of the variance of proportions, multiple linear regression, stepwise regression and analysis of variance.

The investigation revealed that there was a significant relationship between the measures of performance on the free recall tasks and the cloze test results. This relationship remained when the factors of age, sex, reading achievement and mental maturity were considered. The relationship appeared to be strongest for those measures of performance derived from the semantic free recall tasks and weakest for those derived from the linguistic free recall tasks. The relationship did not vary significantly from one article to another, nor, with one exception, from one group to another. However, the relationship did vary significantly from one measure of performance to another.

The examination of the protocols of selected subjects tended to confirm the group results although individual differences were noted. The examination of the selected cloze test responses provided insights into the role of memory processes in reading comprehension.

The results of the investigation indicated that any theory of reading comprehension which wishes to be comprehensive must give consideration to the role of memory processes, and particularly to organization in memory processes. In addition, it appeared that reading programs should attempt to develop the memory processes of readers, possibly through instruction focussing upon the semantic and linguistic patterns of redundancy present in language.

ACKNOWLEDGEMENTS

The writer of this study wishes to acknowledge the assistance and encouragement accorded him during the course of this investigation by numerous individuals. Among those especially remembered are the following.

Appreciation is sincerely extended to Dr. Marion D. Jenkinson, chairman of the committee, whose guidance and example were of invaluable worth.

The writer is indebted to Dr. Myer Horowitz and to Dr. W. H. O. Schmidt who gave so generously and capably of their time and talents on my behalf.

The assistance of Dr. M. J. A. Howe and Dr. J. E. Robertson is gratefully acknowledged. Their constructive criticisms and discussion were appreciated.

It was a privilege and a pleasure to have Dr. A. Raygor as my external examiner. His contributions to the study were helpful and challenging.

The writer appreciated the advice and assistance of Dr. George Cathcart in the statistical analysis of the study.

The cooperation of the administrative personnel, teachers and students of the Grande Prairie School District #2357 helped to make this study possible.

A special note of gratitude is extended to my wife, Kathy. Without her encouragement and faith this study would never have been started.

TABLE OF CONTENTS

LIST OF TABLES

LISTS OF FIGURES

CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

> The first notion to get rid of is that memory is primarily or literally reduplicative or reproductive (Bartlett, 1932, p. 203).

One of the greatest advantages which may accrue from the ability to read and comprehend is the resulting alleviation of the strain on memory. The permanence of printed material allows the able reader to return to the printed message whenever he feels required to do so, thus freeing him from the strain of memorizing large masses of material for later retrieval. However, this does not mean that memory processes are unimportant in acquiring information by reading. Unfortunately, researchers in the field of reading appear to have been lulled by the above mentioned advantage of printed material, for very few have attempted to examine and make explicit the role of memory in reading comprehension.

The necessity for examining the role of memory in acquiring information by reading may be illustrated logically as follows. Memory is a factor in all learning acts. Learning, particularly in the school environment, is almost always cumulative. That which took place previously influences present learning. Events which belong to the past, regardless of the time involved, depend upon memory processes for their re-emergence in the active mental life of the individual. Thus learning is influenced by memory.

Reading comprehension may be considered to be a type of learning. It is learning that is elicited by printed symbols which are formed

into the sequential patterns of phrases, sentences, paragraphs and entire passages. As a result, memory would appear potentially to be involved in reading for comprehension.

Language is sequential and is organized in a linear fashion. As a result, the reader meets information at different points on a page and at different times. But connected discourse demands that the inter-relationship among information be recognized even though the information may be dispersed throughout a page or a passage. It is possible that memory may be involved in providing the connection between the meanings elicited by the language elements encountered on the printed page.

If the above logical argument, even though it may not be exhaustive, can be shown empirically to be valid, in part or in whole, it would appear to have significance for workers in the field of reading. Revealing the role of memory processes in the processing of meaning contained in verbal visual symbols would improve our understanding of the nature of the reading process. Ultimately this understanding must be the basis for rational and long-lasting innovations in reading curriculum and instruction in the schools.

I. Purpose of the Study

It was the purpose of this study to investigate the role of memory in reading comprehension. This investigation took the form of first a theoretical discussion of the possible role of memory processes in reading comprehension, next a statistical analysis of the relationship between performance on free recall memory tasks and the results of cloze tests of reading comprehension, and lastly an examination of

selected cloze responses for illustrations which tended to support the previous theoretical and statistical discussions and an examination of the profiles of selected students.

II. Overview of the Design of the Study

The sample tested in this study consisted of one-hundred and fifty grade six students in six classrooms. In order to examine the nature of the memory processes of the subjects, the free recall paradigm was utilized. Reading comprehension was measured by means of the cloze procedure. This procedure involves the deletion of a specified number of words in a passage with the subject having to fill in the deletion with the correct word. In addition, standardized tests of mental maturity and reading achievement were administered to the subjects.

Three different reading articles were used for the construction of free recall tasks and cloze tests. Three different types of free recall lists were selected from each of the reading passages. These same passages were used for the construction of the cloze tests of reading comprehension. A cloze test of reading comprehension involved the deletion of every fifth word from each of the passages.

Each subject was required to complete the cloze test for each of the articles and to recall one of the free recall lists based upon each of the articles. The type of list was alternated so that each subject received one of each of the three different types of free recall tasks. The relationship between the measures of performance on the free recall tasks and the results of the cloze tests of reading comprehension was examined statistically.

III. Definition of Terms

For the purposes of this study the meanings ascribed to certain terms were as follows:

Categorical Error was an incorrect item in the free recall of a word list which could be classified in one of the categories of the stimulus words (Bousfield, 1953, p. 255).

Chunk was a unit of verbal stimuli resulting from organization being imposed upon verbal input.

Cloze Procedure involved the deletion of every fifth word in a passage to be read.

Clustering was the tendency of words within a given category and presented in random order throughout a list containing more than one category of words to be recalled contiguously in groups.

Free Recall was the active operation of retrieving and reporting the memory of past experiences regulated by the schema organization within the subject and unaided by external control or constraint.

Irrelevant Error was an incorrect item in the free recall of a word list which could not be classified in any of the categories of the stimulus list.

Linguistically Organized List (LOL) was a word list composed of items selected according to their membership in a particular part-of-speech category.

Memory in this study was the ability to recall words presented in a list regardless of order.

Organization referred to the nature of memorial changes that were indicated by an analysis of the occurence of sequential patterns of

modification of the original stimulus material as exhibited by the task of free recall.

Randomly Organized List (ROL) was a word list composed of items selected by means of a table of random numbers from a passage and which contained no predetermined basis for organization in free recall that was evident to the experimenter.

Ratio of Repetition was "the percentage of words recalled that are in clusters (Gonzalez and Cofer, 1959, p. 296)".

Reading Comprehension was considered to be the scores achieved on both the standardized and experimental measures of reading. The experimental measures involved the use of the cloze procedure.

Redundancy was the extent to which items in a verbal message could be predicted from knowledge of other items based upon a recognition of a similarity or identity between elements of a particular message and the consistency observed in other verbal stimuli.

Semantically Organized List (SOL) was a word list composed of items selected according to their membership in a particular conceptual category.

IV. Hypotheses

In the light of the purpose of this research study, the following null hypotheses were formulated.

1. There is no significant relationship between performance on a free recall task and the following factors:

i) age

ii) sex

iii) mental maturity

iv) reading achievement.

2. There is no significant relationship between performance on a free recall task and reading comprehension as measured by the cloze procedure.

3. There is no significant difference between the relationship between performance on a free recall task and reading comprehension as measured by the cloze procedure on one of the three types of recall tasks and the similar relationships on the remaining two types of recall tasks.

4. There is no significant difference between the relationship between performance on a free recall task and reading comprehension as measured by the cloze procedure on one of the measures of performance of free recall and the similar relationships on the remaining two measures of performance.

5. There is no significant difference between the relationship between performance on a free recall task and reading comprehension as measured by the cloze procedure based upon one of the reading articles and the similar relationships based upon the remaining two reading articles.

6. There is no significant difference between the relationship between performance on a free recall task and reading comprehension as measured by the cloze procedure for one of the groups and similar relationships for the remainder of the groups.

V. Questions

In addition to the above null hypotheses, the following questions were explored.

1. Do students in the age range from approximately eleven to thirteen years of age exhibit clustering in the free recall of semantically organized word lists?

2. Do students in the age range from approximately eleven to thirteen years of age exhibit clustering in the free recall of linguistically organized word lists?

VI. Significance of the Study

The primary significance of this study was the possible insights which may have been revealed into the process of reading comprehension. It was believed that significant and long-lasting changes in reading instruction cannot come about until there is sufficient knowledge of the processes involved in comprehension upon which to base these changes.

More specifically, if it was revealed that organization in memory processes is an integral factor in reading comprehension and that this organization is based upon certain specifiable cues, it may be possible to construct reading programs which would explicitly teach young readers to recognize these cues, use them to organize meaning present in a reading passage and thereby improve both the quantity and nature of what is comprehended and retained. Of more immediate benefit, should organization in memory processes have been shown to be involved in reading comprehension, the free recall paradigm could become an examining procedure of the reading clinician.

Furthermore, it was possible that this research project would yield informaton pertinent to an understanding of the role of memory in learning tasks other than reading comprehension.

VII. Limitations of the Study

The following limitations of the study were noted:

1. The students tested for the study came from one grade level only in a small urban centre, and therefore were not representative of the total school population.

2. The semantic and linguistic free recall lists each exhibited only one basis for organization in memory processes. The acceptance or rejection of either of these bases for organization in memory processes did not imply that all other possible bases within either the semantic or linguistic categories would be accepted or rejected.

3. The reading passages used for the construction of the free recall tasks and the cloze tests of reading comprehension were restricted in their scope. No attempt was made to examine technical, literary or other distinct styles of discourse.

4. The reading comprehension skills tested in this study were restricted to those of literal comprehension. No attempt was made to examine such interpretative skills as awareness of mood or the intent of the author.

5. No attempt was made to control for or examine the socio-economic status of the subjects.

VIII. Plan of the Investigation

The investigation was reported according to the following format.

Chapter II contains a theoretical discussion of the possible role of memory in reading comprehension from which a model was constructed.

Chapter III gives the details of the design of the study while

Chapter IV reports the procedures for the construction, administration, and scoring of the experimental instruments.

Chapter V describes the characteristics of the sample while Chapter VI reports the performance of the sample on the experimental measures of memory and reading comprehension. Chapter VII examines the statistical analysis of the data while Chapter VIII reports the results of an examination of selected responses to the cloze tests and an examination of selected individual profiles.

The last chapter, Chapter IX, reports the summary, conclusions and implications of the study.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter attempts to review the available literature pertaining to the role of memory in reading comprehension and the nature of memory processes. From this review conclusions were drawn in support of a theoretical position concerning the possible role of memory in reading comprehension. It is this theoretical position which was examined empirically in this study.

From the available literature concerning the cognitive variables involved in reading comprehension, material was selected pertinent to the problem of the role of memory in comprehension. While recent research and discussion has emphasized the processes that underlie the complex act of reading comprehension, it would appear that little attention has been paid to memory as a cognitive variable involved in comprehension. Furthermore, while memory has received considerable attention from both researchers and theorists, little attempt has been made to relate this information to an applied act such as reading comprehension. By collating the findings from both fields it was hoped that a clearer understanding may be gained of the role of memory processes in comprehension.

The first section of this chapter outlines current insights into the role of memory in reading comprehension Section two examines the recoding and unitizing hypotheses. An analysis of the studies pertaining to organization in memory process follows in section three. The last section attempts to integrate the above information and construct a

possible model of the role of memory processes in reading comprehension.

I. Memory Processes and Reading Comprehension

> When as much is known about the subskills of comprehension and interpretation as is now known about the subskills of word analysis, a more balanced program can be offered (McCullough, 1968, p. 237).

In spite of the above advice, it would appear that little consideration has been given to the role of memory processes in reading comprehension and, consequently, to those memory subskills which may be required for accurate, thorough comprehension. Attempts to synthesize the information available concerning reading comprehension have occasionally made no reference to memory processes (Cleland, 1966) or, more often, have only vaguely delineated the role of memory in comprehension (Smith, 1960, p. 23 - 24; Strang, 1965, p. 59; Deighton, 1967, p. 323; Ruddell, 1968, p. 70). This is a strong indication of the paucity of research concerning memory processes and reading comprehension. This scarcity may have been caused either by a lack of awareness of recent findings in the field of memory or by the decision to avoid this area because of the difficulties involved.

Several writers have considered the role of memory in reading comprehension in some detail. Spache (1966) constructed a scheme of representation for reading comprehension based heavily on the earlier work of Guilford (1959, 1960). In summary form, he considered the role of memory with various levels of content to include the following:

> Unit-The Word: During the latter part of his preschool years, the child begins to recall or remember specific word meanings when he encounters a printed word such as his own first name (p. 68).

> Class-The Sentence: Comprehension of a sentence involves holding the successive thoughts in mind until the sentence is finished (p. 69).
>
> Relations-The Paragraph: To comprehend a paragraph, the reader must be able to keep in mind the ideas contributed by the successive sentences until the end of the passage (p. 70).
>
> Systems-He (the reader) can recall the particular order or system of the facts and their total meaning in his own words in an arrangement which reflects the author's organization (p. 71).
>
> Transformations-In remembering the content of the paragraph, the reader may form unusual or novel associations with other ideas (p. 72).
>
> Implications-Recall of the implications of the authors view-point may be shown in tasks involving selection of the best possible statement of these implications (p. 72).

No research findings were cited to confirm these statements. The present research project may have cast some light on the processes underlying the skills indicated by Spache.

Barrett, quoted by Clymer (1968, p. 19 - 23), attempted to develop a taxonomy of affective and cognitive factors involved in reading comprehension. He included recall as one of the dimensions of the taxonomy and stated that:

> Recall requires the student to produce from memory ideas and information explicitly stated in the reading selection (Clymer, 1968, p. 20).

Barrett indicated six recall tasks: Recall of Details, Recall of Main Ideas, Recall of a Sequence, Recall of Comparisons, Recall of Cause and Effect Relationships and Recall of Character Traits.

Barrett also included as a dimension of his taxonomy a reorganization factor and stated that:

> Reorganization requires the student to analyze, synthesize, and/or organize ideas or information

> explicitly stated in the selection (Clymer, 1968, p. 20).

While Barrett did not indicate a possible relationship between recall and reorganization, the review of the literature on memory processes contained in a later section suggests this possibility. This research project was designed to examine this possibility.

Goodman has presented a model of the reading process described as a "psycholinguistic guessing game (1967, p. 134)", in which he indicated that "there is constant use of long and short term memory (1967, p. 135)". He has indicated that knowledge of phonological, syntactic and semantic cuing systems is stored in long term memory and used as a basis for searching for and selecting similar cues from a printed message. The cues selected from a particular graphic message are stored in short term memory and used as a basis for matching cues stored in long term memory and making a tentative choice for the symbol on the page. This choice is then stored in short term memory until it is either accepted or rejected on the basis of other tentative choices made in a similar fashion. If the choice is accepted, meaning is assimilated (1967).

Goodman has indicated that the knowledge of syntactic and semantic cuing systems that is stored in long term memory (1967, p. 541) is part of a deeply internalized knowledge of the structure of the language which a reader brings to the printed page (1968, p. 24). He has also indicated that proficient silent readers may edit out a good deal of redundant language information (1968, p. 19). Some of these concepts appear to be similar to those upon which this study was based.

However, while Goodman has analyzed the miscues of young readers (1965) from which he derived his model, he has not as yet attempted to

explain or examine empirically the nature of memory functioning in reading comprehension. In addition, he appeared to imply that comprehension takes place automatically after the language message has been recreated. It would appear possible that the recreated message may also require processing if it is to be comprehended and thus memory processes may be involved in this aspect of reading as well.

While little research has been done on the role of memory in reading comprehension, several studies have indicated the possibility of such a role. Raymond (1952) used a variety of memory and associative learning tasks with superior readers aged nine to eleven years and compared their performance with that of retarded readers studied previously. While the majority of the tasks did not relate to the comprehension process, one finding was of interest. It was discovered that reading achievers made significantly higher scores in the recall of related than of unrelated items when presented auditorily (p. 102). The related material consisted of sentences while the unrelated material consisted of unrelated one syllable words. However, the retarded readers exhibited no particular pattern of differences. This may have indicated that the good readers, in general, were able to attend to the cues in related material, reorganize the material on the basis of these cues and thus improve their performance. Poor readers, in general, may not have used these cues to improve their memory performance.

Burks and Bruce (1955) examined the characteristics of good and poor readers on the WISC. Using a sample of eleven good and thirty-one poor readers from grades three to eight, they found that while the subtests of Coding, Information and Arithmetic were relatively low for the poor readers, those of Comprehension, Block Design and Picture

Arrangement were relatively high. They concluded that the latter three sub-tests required little memory since the stimulus was readily available, while the former three required memory functions. The researchers stated that:

> Since the reading process inherently consists of abstractions strongly depending on memory functions, these children are handicapped. The good readers, on the other hand, do not show this lack of ability to use abstractions and have much more retentive ability (p. 493).

Robeck's findings on the intellectual strengths and weaknesses of reading clinic cases also revealed a weakness in the ability of subjects to recall verbal material (1963).

Wilson (1966) attempted to investigate the notion that certain syntactic structures function as "chunks" which are processed as units in the short term memory of young readers. He examined the ability of thirty-four grade three students to memorize individual words, three-word phrases and three-word non-syntactic strings. The results were related to comprehension, vocabulary and total reading test scores. Wilson found that individual differences in recall at the phrase level showed a positive co-variance with general reading competency and he concluded that immediate memory does play a role in the reading task. However, the experiment did not yield any clear cut results either to support or to deny the notion of chunking in young readers.

Rodgers (1966) examined the auditory memory of retarded readers in grades four to six with a control group of achieving readers. He found that the "digits backward" task, in which the subject had to hold in mind a string of digits presented and repeat them in reverse order, was the task which best discriminated between retarded readers and the

control group (p. 114). He surmised that perhaps this task involved some cognitive ability which the poor reader lacked and that perhaps this ability was to operate upon a sequence of stimuli held in the mind of the reader (p. 128). A later study by Rodgers (1968) using younger students concluded that there was a strong probability that poor auditory memory is a causal factor in reading retardation at the grade two level.

Thus it appeared that some attempts had been made to explain the role of memory in reading comprehension. However, these attempts appeared to have been hampered by the paucity of available research and the resulting lack of knowledge from which to theorize. The few studies which were relevant indicated the possibility that memory processes are involved in reading comprehension. However, this possibility had not been vigorously examined nor had the nature of this involvement been analyzed and made explicit. It appeared that possible insights into the nature of the role of memory processes may be gained from an examination of both theory and research pertaining to the nature of memory processes. The following sections attempt to examine one current theory of memory processes which appeared to have support among many psychologists and the research pertaining to this theory.

II. Recoding, Unitizing and Memory

Interest in the memory processes of man has deep roots in philosophy (Furlong, 1951). Psychological interest in the problem, initiated by Ebbinghaus (1913) near the end of the 19th century, flourished for a period of time and later waned. Recently interest in memory phenomena has been revived, a revival in which an influential paper by Miller (1956)

played no small part.

In the interim between the decline of interest in memory phenomenon and the Miller article of 1956, several publications were significant in that they foreshadowed the discussion to come. One such publication was that by Bartlett (1932). He set forth the view that memory is not simply reproductive but rather reconstructive. As a result of a qualitative analysis of a series of experiments using both verbal and visual materials and requiring retention for both short and long periods of time, Bartlett concluded that what was remembered was not the event itself but a general rule of arrangement or schema of the event and that this schema was used as a basis for reconstruction of the original event. Accurate recall is the exception rather than the rule, since reconstruction of the event is based not simply on the input event but also on past learning and knowledge. Bartlett stated that the input is viewed on the basis of past knowledge in an "effort after meaning (p. 227)" which forces subjects to simplify material, to make it more logically coherent, to put it into more conventional language if it is verbal and, to add, distort and omit details. He concluded by stating:

> Remembering is thus only one special form of the general problem of meaning, and occurs when the setting of a particular group of stimuli is treated and described as belonging to the past life of the remembering subject (p. 237).

Bartlett's work with connected discourse was followed by Paul (1959) and Alin (1964) both of whom confirmed and elaborated upon his results.

The concepts, developed by Bartlett, that recall is largely recreation based upon a general schema rather than simply reproduction

of an input event, and that the processing of events for storage and retrieval is influenced by past learning and knowledge were revived in later work.

An influential book first published in 1949 by Hebb (1961) expressed a neuropsychological view of mental activity. Rejecting a simple S-R view of behaviour (p. 5), Hebb attempted to establish the nature of constancy and organization in behaviour. Hebb stated that transmission of neural impulses is not simply linear within neural pathways but may involve closed or recurrent circuits with cells firing in recurring patterns (p. 10). He attempted to show that the memory trace, the basis of learning, is both structural and static (p. 12). He developed the concept of the well-organized phase-sequences, interconnected patternings of cellular material, which are permanently stored and provide constancy in behaviour. Hebb referred to these as conceptual in nature (p. 126) and relatively free from environmental dominance (p. 126). These organized sequences may be activated by environmental events to the extent that these events relate to their central organized core (p. 128), and both enable cumulative learning and restrict the individual to learning which is not entirely novel. Thus, organized sequences stored in the mind of the individual screen environmental events and function as a type of unit. The concept of the mind organizing incoming stimuli into recurring patterns which can be stored in the memory and run off as units was crucial to the later revival of interest in memory processes.

Lashley (1960) first published an article in 1951 which dealt with serial order in behaviour. In an attempt to explain "The logical and orderly arrangement of thought and action (p. 506)" as occurred in

verbal behaviour, Lashley rejected the explanation of "direct associative linkage (p. 520)" in favour of a cerebral mechanism which determines the serial order of both motor and thinking events independent of those events (p. 511). He hypothesized the existence of "elaborate systems of interrelated neurons (p. 520)" which acted as generalized schemata for ordering acts. The concept of an awareness of order in events, which is generalized and freed from specific events, reappeared in the later work on the nature of memory processes for language.

While the works cited above were influential and foreshadowed later developments, it was perhaps the work of Miller that was most influential in reviving the theoretical discussion of the nature of memory processes. Miller, in his paper (1956) started his discussion by outlining an apparent contradiction in the findings on memory abilities. It was a well documented finding that the span of immediate memory is severely limited in man (Keppel, 1968, p. 178). Miller concluded after reviewing a number of studies that man can remember seven plus or minus two discrete units of information; that is, from five to nine isolated instances. However, it was intuitively obvious that man can remember vast amounts of information over long periods of time. Miller addressed the problem of the resolution of these two findings. To resolve this apparent contradiction between the small immediate memory span and the large long term memory capacity of man, and to explain the nature of memory processes, Miller put forward the unitizing and the recoding hypotheses.

After reviewing a number of studies, Miller concluded that the amount which can be held in immediate memory is dependent upon the

number of units involved and not the amount of information. The concept of information used here was derived from information theory and referred to an abstract measure of the ability of decisions to remove uncertainty. Information, in this restricted sense, was measured in "bits".

> One bit of information is the amount of information that we need to make a decision between two equally likely alternatives (Miller, 1956, p. 87).

Units were composed of bits of information and were called "Chunks". Thus, Miller stated:

> Since the memory system is a fixed number of chunks, we can increase the number of bits of information that it contains simply by building larger and larger chunks, each chunk containing more information than before (1956, p. 94).

Thus the discrepancy between the restricted immediate memory span and the almost unlimited capacity of long term memory was resolved by hypothesizing that a human information processor is not limited to the given stimulus, but may modify, manipulate or organize the stimulus input into a sequence of informationally richer chunks.

The unitizing and recoding hypotheses attempted to explain the above process. The unitizing hypothesis referred to the ability of individuals to group or "chunk" discrete items in a stimulus array. That is, the human processor may impose organization upon the incoming stimulus which groups a number of items together and thereby reduces the number of units to be remembered, while increasing the amount of information contained in any one unit. The recoding hypothesis referred to the content of the units. That is, if the input material may be said to be in the form of a code, the individual can change the nature of the code or recode. This view stressed the role of cognitive

organization in memory as crucial to the memory act.

A specific example given by Miller illustrated these twin processes.

> A man just beginning to learn radio-telegraphic code hears each dit and dah as a separate chunk. Soon he is able to organize these sounds into letters and then he can deal with letters as chunks. Then the letters organize themselves as words, which are still larger chunks, and he begins to hear whole phrases...I am simply pointing to the obvious fact that the dits and dahs are organized by learning into patterns and that as these larger chunks emerge the amount of message that the operator can remember increases correspondingly. In the terms I am proposing to use, the operator learns to increase the bits per chunk (1956, p. 94).

Miller has elaborated upon the nature of this recoding. He has indicated that one of the easiest ways to recode is to group the input events, apply a new name to the resulting group and remember the new name (1956, p. 93). This increases the amount which can be remembered, in the sense of being recreated from the new code. Miller also stressed that a great deal of learning has gone into the formation of the chunks and the new code, thus indicating the possibility of learned strategies of recoding and unitizing (1956, p. 92), a possibility that was supported by the research of Shipstone (1960).

In an earlier work, Miller (1951) had discussed the phenomenon of language redundancy. Natural languages do not use every mathematically conceivable combination of symbols to convey meaning but restrict possible combinations according to definite rules. In addition, the symbols used may convey the same information more than once. As a result, later symbols may, to some extent, be predicted from earlier symbols if the rules of combination are understood and the individual

is aware of the duplication in the message.

> Words do not present themselves in random, unorganized ways. Sentences hold together as units, and the component parts complement and modify one another according to their patterning (1951, p. 4).

This redundancy safeguards communication and acts as an insurance against transmission misinterpretations (Eisenson, 1963, p. 179). However, Miller considered that in processing natural languages, the recoding may eliminate at least some of this redundancy and make each symbol carry a greater portion of the communication load (1951, p. 234). This effectively reduces the amount which has to be remembered, provided that the new code is accurately retained and used precisely in recreating the information (Postman, 1963, p. 46).

Miller and his associates have examined the use of redundancy empirically. An early experiment by Miller and Selfridge (1950) examined the ability of subjects to remember sequences of words that were composed with greater or lesser degrees of contextual constraint. Constraint was provided by creating the strings of words according to less and less random rules of arrangement. The researchers found that the percentage of recall for the strings was affected positively by the degree of verbal constraint and negatively by the length of the list. In addition, the longer the passage, the greater the use of contextual constraint in facilitating recall. The experimenters concluded that the material in verbal context facilitated the use of previously learned knowledge of regularities in the language and thus increased positive transfer. The results were duplicated later by Marks and Jack (1952).

Miller, Heise, and Lichten (1951) used an articulation test with syllables, words and sentences to examine the role of context in the

perception of units. The articulation test consisted of an announcer reading lists of units over headphones to a subject who was required to report what he heard immediately. Various levels of noise were introduced to ascertain the amount of information required to transmit a symbol. The results showed that nonsense syllables were more difficult to hear than digits and that words in sentences were more easily understood than words in isolation. The experimenters concluded that the reason for the latter finding was that increased context limited the number of possible alternatives from which a test item had to be chosen. Thus the subjects appeared to be capable of making use of the redundancy in the messages.

A later experiment by Miller (1958) utilized redundant and non-redundant or random combinations of four letters, G, N, S and X. Subjects were asked to recall sets of combinations of these letters. It was found that redundant strings were learned more quickly than random strings. Miller hypothesized that this was a result of the possiblity of recoding redundant strings. However, it was also found that shorter, random strings provided a more efficient method of storing information, when the degree of contextual constraint was controlled. A less redundant code, as would occur after recoding, approximates a shorter, random string.

Experiments by Aborn and Rubenstein (1952) and Rubenstein and Aborn (1954) also indicated that redundant material was recalled in more detail but that less redundant and inter-connected material was informationally richer. Later experiments by these two researchers indicated that subjects were very sensitive to language redundancy (Aborn and Rubenstein, 1958) and that effectiveness of contextual

constraint may vary with position and length of the context (Aborn, Rubenstein and Sterling, 1959).

Morton (1964) examined the oral reading and eye-movements of thirty-two adult subjects with material exhibiting increasing degrees of contextual constraint. He found that the speed of reading increased with greater constraint, more so for fast than for slow readers, that material in the eye-voice span increased with greater contextual constraint, more so for the fast than for the slow readers, and that regressions lessened with contextual constraint. Thus, redundancy, in the form of contextual constraint, appeared to affect oral reading. However, comprehension was not examined.

A later work by Miller (1960) elaborated upon the individual's understanding of the nature of language redundancy as a variable in the understanding and retention of natural languages. Miller and his associates took the somewhat revoluntionary stand that "the person must be aware of the underlying structure of the sentence in order to understand it (1960, p. 153)". This meant that the person must be aware of the patterns of redundancy present if he is to be able to recode, unitize and thereby process the sentence for understanding.

One aspect of language redundancy is represented by the rules of grammar or syntax. Understanding of the patterns of redundancy generally involves at least implicit understanding of the syntactic rules of the language. This led Miller and his associates naturally to consider the role of linguistic rules as they affect recoding and unitizing in understanding language. As a result of working closely with Chomsky, Miller turned to transformational grammar as the most viable statement of the rules of syntax which a human would have to

understand at least implicitly if he is to be able to understand language. Thus Miller stated that the hierarchical structure of language may be used as a basis for looking for a hierarchy of cognitive units (1967, p. 12). He thus believed that one cannot understand a sentence until he is able to assign a constituent structure to it (1967, p. 205) and has hypothesized that possibly what people remember of a sentence is the kernel and a footnote about syntactic structures (1967, p. 216). In addition, Miller believed that the learning of the syntactic rules of the language affects the strategies whereby the language message is unitized and recoded (1967, p. 13).

Miller and Isard (1963) examined empirically the "assumption that in order to understand a spoken message it is necessary to process the linguistic rules and that perception is more accurate when this processing can be performed in its habitual fashion (p. 219)". The experimenters constructed three sets of stimulus materials. The first set consisted of regular grammatical sentences, all of which possessed the same phrase structure. The second set was composed of ungrammatical strings of words. A third set was composed of syntactically acceptable but semantically anomolous strings. Subjects were required to shadow, that is, to repeat aloud immediately afterwards, the tape recorded stimuli. The recorded responses indicated that under both regular and masked conditions grammatical sentences were perceived significantly better than anomolous sentences, which in turn were perceived significantly better than ungrammatical strings. The authors concluded that the subject's ability to use context was derived from an intimate though tacit understanding of both linguistic and semantic rules of the language. This conclusion was reached in a later experiment as well

(Mark and Miller, 1964).

It is important to understand what was meant by linguistic and semantic components in the above two experiments. The experimenters took five normal sentences of five words each with identical syntactic structure (adjective-plural noun-verb-adjective-plural noun) and created anomolous and anagram sentences from them. The anomolous sentences were created by taking the first word from the first position in the first sentence, the second word from the second position in the second sentence and so on. Anomolous sentences were considered to be syntactically identical to the normal sentences but to violate the semantic structure of the sentence. Anagram sentences were constructed by taking a normal sentence and randomly scrambling the word order, thus violating the syntactic structure while maintaining the semantic component, even though the semantic component may have been affected by the randomized order. This definition by violation failed to define explicitly the nature of the semantic and linguistic rules which the subjects were able to use. Thus, researchers who wished to pursue this line of endeavour were left to formulate these definitions for themselves.

An additional drawback of this technique of defining linguistic and semantic components through violation was that it may leave the impression that these two components operate in isolation one from the other. However, this may not be so. There may exist a mutual dependence between them. Zelig Harris (1964), in examining semantic and linguistic components in connected discourse, has made the point that the semantic meaning of a morpheme may change as its position in a particular context is altered. One such example is the change from

the position of subject of the sentence to that of object of the sentence. Thus, while it may be justifiable for purposes of analysis to consider the two components separately, their interrelationship must never be neglected.

Other researchers have examined several of the ideas put forward by Miller. Epstein (1961, 1962) examined the influence of syntactic structures on the memorization of strings of symbols. The findings indicated that syntactic structure facilitated recall but only when the materials were presented in a continuous sequence. Mehler (1963) found evidence that what subjects remembered about a sentence was the kernel and a note about the type of transformations required to turn it into an interrogative, passive or imperative sentence, thus indicating another possible form of recoding. Johnson (1965, 1966) examined the psychological reality of constituents as integrated units in a memory task and found evidence to support the hypothesis. Fodor and Bever (1965) examined the constituent as a unit using a different technique and found similar results. These studies tended to support the unitizing hypothesis.

Miller summarized his theory of language processing as follows:

> It is conceivable that all complex, symbolic learning proceeds in this way. The material is first organized into parts which, once they cohere can be replaced by other symbols...and eventually the whole scope of the argument is translated into a few symbols which can be grasped at one time (1967, p. 10).

The recoding and unitizing hypotheses introduced by Miller have been constant themes in the literature since that time. In addition, the concept that learned strategies for recoding and unitizing are based on knowledge of language redundancy, as exemplified by linguistic

and semantic components, has also received considerable emphasis.

While reading educators had not attempted to examine these concepts in relation to reading, the possibility existed that they may be of value in attempting to explain the cognitive processes underlying comprehension. For example, does recoding take place as a child reads? Do students chunk material that is being read? If either or both processes take place, are these processes affected by the child's internalized knowledge of the linguistic and semantic cues present in language? Such questions appeared worthy of further consideration for those interested in reading comprehension.

Redundancy in Language

The theoretical viability of the above hypotheses rested, at least in part, upon the existence of redundancy in natural languages. Garner (1962) has addressed this problem in some detail. He has defined redundancy as:

> When we have a system of variables and do not use all of the possible combinations of the variables, then we have redundancy (p. 161).

Through the use of information theory and the measurement of information as a quantifiable commodity, Garner has estimated that the sequential constraint in printed English, one aspect of redundancy, reaches a maximum of a little more than fifty percent. He concluded that:

> These values are of considerable interest, since they show the extent to which the language can be recoded into a more efficient code (p. 239).

While the exact figure is perhaps debatable, there is little doubt that natural languages are highly redundant and therefore quite capable of

being more economically recoded once they are received.

It must be kept in mind, however, that Garner was speaking of primarily of sequential restraint when he gave a figure of fifty percent. Sequential restraint refers to the fact that not every type of word, or part-of-speech, can follow every other type of word. For example, while a noun is likely to follow an article, a verb never occurs in this position. Thus, Garner was referring primarily to structural redundancy in language and not to semantic meaning (p. 144). However, the research by Miller and Isard (1963), Mark and Miller (1964) and Slobin (1966) has indicated that not only were subjects able to utilize structural or linguistic cues in learning or comprehending sentences but that they were also able to utilize semantic cues as well. This made it appear likely that there may exist a semantic redundancy whereby certain meanings are more or less likely to occur than others and that there exists an internal correlation of the semantic meaning of items in a message. This made the hypothesis of semantic recoding appear possible. This possibility had been suggested as well by Quillian (1968, p. 228) and by Fodor, Jenkins and Saporta (1967, p. 185).

Garner differentiated between internal and external constraint or redundancy. Internal constraint referred to the amount of correlation of items within a symbol system while external constraint referred to the correlation between the symbol system and some external referent system of variables (1962, p. 149 - 150). Internal constraint would appear to be the type which is the basis of recoding as it occurs in the processing natural languages. Garner stated that:

The psychological performance criterion which

> is most closely related to internal constraint or redundancy is free-recall learning (1962, p. 167).

Free-recall learning was considered to be an index of the extent to which an individual is sensitive to or can use language redundancy because the introduction of redundancy provides something for the subject to learn, the redundancy itself (Garner, 1962, p. 168). Redundant material allows the subject to utilize the rules and strategies which are available to him to organize and recode the material. To the extent that the material allows the subject to use the rules available to him, the more accurate will be his recall, as indicated by the Miller and Isard experiment (1963). In addition, Garner indicated that the extent to which redundancy is used by human subjects depends upon their skill in using the language (1962, p. 257).

Utilization of Syntactic Redundancy and the Integration System

The question of the manner in which knowledge of language redundancy, at least as it pertains to syntax, helps in the unitizing and recoding processes, has been discussed from a theoretical point of view by Osgood (1964). In an hypothesized model of language behaviour, Osgood considered three levels of organization between the stimulus and the response in a complex behavioural act. Only the latter two are involved in language activity, the integration level and the representation or cognitive level. The chief function of the integration level is to organize and sequence both incoming and outgoing events and bears some resemblance to Lashley's generalized schemata for ordering acts (1960). The chief functions of the representational level are the highly symbolic acts normally associated with

thinking.

The integration system serves to alert the representation system to certain probable meanings in a language message. These restrictions are based upon the syntactical restrictions in the language of which the individual is aware. Osgood stated:

> At each point in a language message, then, we have a hierarchy of structural alternatives, this hierarchy varying in its probabilistic character with the grammatical restrictions in the language as a whole (1964, p. 192).

The integration system, by organizing the input of a language message, may form units based upon the individual's knowledge of the syntax of the language.

Osgood commented upon the nature of units at the integration level. He stated:

> Given the principles by which the integration systems work, the units must tend toward the largest segments of language that are a) highly redundant, b) very frequent in occurrence, and c) within the temporal limits of cell-assembly reverberation (1967, p. 118).

In addition, Osgood stated:

> The more stimulus events dispersed in either space or time tend to follow regular or predictable sequences, the more likely are they to be perceived as a group (1965, p. 52).

While the above refers primarily to the nature of units that exist in the integration system based upon linguistic cues, Osgood has also indicated the possibility of units at the representational or semantic level as well (1965, p. 71).

Thus, Osgood has indicated a possible way in which unitizing for recoding is affected by knowledge of language redundancy. Linguistic cuing systems alert the individual to patterns of recurring redundances

which become the basis for units which are recoded.

Abstractions and Recoding

The concept of recoding has received attention from Bruner (1957). While Miller examined the concept as it facilitated memory and as it applied primarily to language processing, Bruner has viewed recoding in conceptual terms. He defined coding as "the learning of certain formal schemata that may be fitted to or may be used to organize arrays of diverse information (1957, p. 295)". One way of organizing information is to learn the redundancy of the environment. After knowledge of the redundancy of the environment has been thoroughly mastered, a necessary condition, a more generic code may be created by performing an abstracting or "emptying" operation on the information which strips away the redundancy. The resulting more generic coding system enables the individual to "read off (1957, p. 298)" additional information based on learned principles of relating material. Thus from the more generic code the original material may be remembered in the sense that it can be recreated, a concept similar to that held by Bartlett (1932).

An experiment by Bruner and Olver (1963) attempted to examine the code creating abilities of elementary school children. Each subject was presented with one word at a time from a list of nine words and was asked to tell in what way the new word was both alike and different from those presented previously. The responses were recorded and analyzed into three basic types: those which formed a true superordinate concept for the list, those which formed a complex which did not subordinate the entire array to any set of properties, and those which strung words together thematically. These three categories corresponded

to the three types of codes created. The authors concluded that:

> The development of intelligence...moves in the direction of reducing the strain of information processing by the growth of strategies of grouping that encode information in a manner a) that chunks information in simpler forms, b) that gains connectedness with rules of grouping already formed, and c) that is designed to maximize the possibility of combinatorial operations such that groupings already formed can be combined and detached from other forms of grouping (1963, p. 133 - 134).

The similarity between the ideas of Bruner and Miller was considerable, even though they had approached the problem of coding from different points of view. The discussion by Bruner, however, may have indicated the nature of the process whereby recoding is accomplished, that is, abstraction. The process of turning one code into a more generic one may involve abstraction of criterial components out of redundant units. In language processing, these units may be dictated by the individual's knowledge of linguistic and semantic rules of the language. In addition, the experiment described above indicated the possibility that strategies for recoding, and consequently the nature of memory processes, may change or develop with increasing maturity.

Development of Memory Codes

Piaget has examined the possibility of a modification or development of memory processes in the child within the framework of his developmental theory. Piaget believed that memory is an aspect of intellectual activity.

> ...memory seems to be a special case of intelligent activity, applied to the reconstruction of the past rather than to knowledge of the present or anticipation of the future (1968, p. 15 - 16).

As such it is subject to the development in the child of basic

schemes of operation.

> A scheme for Piaget is here, as always, the coordination and organization of adaptive action, considered as a behavioural structure within the organism such that the organism can transfer or generalize the action to similar and analogous situations (Furth, 1969, p. 44).

Piaget examined the proposition that:

> ...the most likely hypothesis is that the memory code itself depends on the subject's operations, and that therefore this code is modified during development, and depends at any given moment on the subject's operational level (1968, p. 2).

Piaget and his associate, Inhelder, conducted a series of experiments with children aged three to twelve in which the children had to report their memory of a variety of concrete situations at various time intervals. The results supported the hypothesis that the memory for an event would be affected by the level of intellectual development of the subject. In addition, it was discovered that an individual's memory for an event could be improved after six months as a result of the child's intellectual development in the interim (Inhelder, 1969, p. 357).

These experiments resulted in the delineation of three types of memory corresponding to three levels of development, the recognition, the reconstruction and the evocation types of memory. Piaget described the three types as follows:

> Recognition can rely on perception and sensorimotor "schemes" alone, while evocation requires mental imagery or language, that is, some form of symbolic function, some form of operational representation (1968, p. 11).

> ...reconstruction memory, which we can observe when we give the subject the material which was used to construct the model (along with some extra material), and ask him to rearrange the material in the configuration which he had seen

earlier (1968, p. 12).

Furth summarized Piaget's concept of memory functioning as follows:

> ...memory performance, being in no case a direct copy of a passively received perception, depends most on operative schemes and can be expected to show corresponding changes as these schemes develop or change in importance (1969, p. 154).

This idea bears great similarity to the concepts of Bartlett (1932) whom Piaget quoted in his writing.

Thus it appeared that the nature of memory processes may change with development. If strategies for recoding may be said to be controlled by Piaget's schemes of operation, it was possible that recoding may change with increasing maturity as well. Since nearly all of the experimentation had utilized young adult subjects, this possibility had yet to be explored.

Summary

In order to indicate their relevance to the present study a review of the concepts developed above follows. It is important to remember that these theories developed in response to findings in the field of memory; the discrepancy between the small finite immediate memory span and the relatively infinite long term memory capacity. The processes described are memory processes having to do with the nature of memory in processing language. Attneave has indicated that all transmission of language messages requires storage for at least a brief period of time (1959, p. 78). The view of memory expressed stresses the role of cognitive organization in memory and its effects upon higher mental processes.

The recoding and the unitizing hypotheses were put forward by Miller to resolve the above mentioned discrepancy and to explain the role of organization in memory. The two hypotheses postulated the ability of the human processor to perceive organization based upon redundancy in a complex whole and to re-organize this whole into a more efficient package which carries large amounts of information in few units. Learned strategies for unitizing and recoding are strongly influenced by the individual's knowledge of the language being processed. To the extent that natural languages are redundant and the processor is aware of this redundancy, recoding is possible. The redundancy present in natural languages appeared to be of two types, linguistic and semantic, the former referring to the word classes and their possible combinations, the latter to the representational meaning of the symbols. Learned strategies for organization in memory for language would appear, therefore, to refer to these components. In addition, Piaget appeared to have indicated that these strategies may change with increasing maturity.

The process of abstraction may be involved in recoding. The stripping away of redundancy to create informationally rich items may involve abstraction. Unitizing may take place at the integrational level as a result of awareness of systems of language cues which facilitate organization.

The above ideas attempted to examine the role of memory in processing a complex system of language. Children meet such a system and are involved in such processes when they are reading. However, as the review of the literature on the role of memory in reading comprehension indicated earlier there appeared to be little awareness of these

complex processes on the part of reading educators, and, consequently, children receive little direct instruction which would facilitate the growth and development of memory processes in reading comprehension. As a result, it appeared desirable to study the role of memory in reading comprehension in the hope of eventually developing a program of reading instruction which would be aimed at improving these complex processes in young readers.

Since the theoretical structure was based upon findings in the field of memory, and since free recall has been considered to be the most relevant psychological measure of awareness of internal redundancy, it was necessary to review some of the work on organization in memory and free recall.

III. Organization and Memory Processes

The recent revival of interest in memory has focussed less on rote memory and more on the role of memory in meaningful learning. Rote memory may be considered to involve the retention of material, either meaningless or potentially meaningful, usually by repetition, but in a manner which does not stress the link between the new stimulus and existing knowledge and cognitive organization. Meaningful memory, however, involves the retention of meaningful material strongly influenced by existing knowledge and cognitive organization

Ausubel (1968) has commented on the role of memory in meaningful learning. He first noted a dilemma similar to that from which Miller (1956) started.

> The acquisition and retention of large bodies of subject matter is really a very impressive phenomenon considering that: a) human beings,

> unlike computers, can apprehend and immediately remember only a few discrete items of information that are presented just a single time, and b) memory for rotely learned lists receiving multiple presentations is notoriously limited both over time, and with respect to length of list, unless greatly overlearned and frequently reproduced (p. 58).

Ausubel then went on to explain the role of meaningful memory in overcoming the above limitations.

> First, by nonarbitrarily relating potentially meaningful material to relevant established ideas in his cognitive structure, the learner is able effectively to exploit his existing knowledge as an ideational and organizational matrix for the incorporation, understanding and fixation of large bodies of new ideas (1968, p. 58).

> Second, the substantive or nonverbatim nature of thus relating new material to, and incorporating it within, cognitive structures circumvents the drastic limitations imposed by the short item and time spans of rote memory on the processing and storing of information (1968, p. 59).

The above related memory firmly to learning. Melton has indicated that a theory of memory is a fundamental component of a theory of learning (1963, p. 296). He explained the relationship between the two concepts as follows:

> By convention among psychologists, the change from Trial N to Trial N + 1 is referred to as a learning change when the variable of interest is the ordinal number of Trial N and not the temporal interval between Trial N to Trial N + 1 and the change from Trial N to Trial N + 1 is referred to as a retention change when the variable of interest is the interval and the events during the interval between Trial N and Trial N + 1 (1963, p. 297).

Ausubel has concurred:

> Retention, therefore, is largely a later temporal phase and diminished aspect of the same phenomenon or functional capacity involved in learning itself

(1968, p. 98).

Newell and Simon (1967) have indicated, as have Bruner, Goodnow and Austin (1956), that short term memory load has important effects on the strategies that subjects choose in concept-attainment tasks.

Thus memory is very much a cognitive variable which influences new learning and processing. Newly learned materials become subject to the organizational principles governing retention (Ausubel, 1968, p. 108). These organizational principles were hypothesized by Miller to involve unitizing and recoding.

Mandler (1967) has discussed the role of organization in memory. He defined organization as follows:

> A set of objects or events are said to be organized when a consistent relation among the members of the set can be specified and, specifically, when membership of the objects or events in subsets (groups, concepts, categories, chunks) is stable and identifiable (1967, p. 330).

One may note the similarity of this definition to that of redundancy in language provided by Garner (1962, p. 161).

Mandler believed that organization is fundamental to memory and that recoding is the vehicle of organization.

> In summary, organization is absolutely necessary if memory is to exceed the limit of individual items that the system can deal with at any one time. This process of organization involves recoding the input material into new and larger chunks. Memory consists of the recall of a limited number of chunks (that is, about seven) and retrieval of the contents of these chunks (1967, p. 331).

In addition, Mandler has elaborated on the nature of recoding. In a series of experiments he found that very loose categories or chunks containing large numbers of items may themselves contain second-order chunks. Thus, while the number of within chunk items is limited, the

possibility existed of chunks within chunks. Thus Mandler hypothesized the existence of a hierarchical system of recoding. The stimulus in - put is recoded into chunks with a limited set of items per chunk. These chunks are further recoded at the next level of organization where first-order chunks are formed into second-order or "superchunks" and so on (1967, p. 332). This hierarchical concept of recoding bears great resemblance to the notion of the hierarchical system of language components.

Adams (1967) has commented on the role of what he terms natural language mediators (NLM) in organization of memory. He stated that the subject in a memory experiment may impose structure on a set of stimuli by using language to form connections between items. In this event, the mediator becomes the stored unit. However, Adams indicated that natural language mediators may be fallible and may lead the subject astray (1967, p. 131 - 134).

Norman (1969) has given one possible explanation of the role of organization in memory. Organization was conceived as the method whereby material is transferred from a primary, short term memory system of limited capacity to a long term system of relatively un-limited capacity.

> A number of recent studies of memory have emphasized the role of organization in the learning of verbal material. These studies appear to provide us with a link between the limitations of primary memory and the large capacity of secondary memory through the mechanism of proper and efficient organization. The basic idea arises from Miller's realization that although we seem able to learn no more than seven (plus or minus two) things at one time, each of these things can be rich in structure and meaning (1969, p. 119).

The relationship between short term and long term systems has been elaborated upon by Atkinson and Shiffrin (1968; 1969). They have postulated three basic components within the memory system, a sensory register, the short-term store (STS) and the long-term store (LTS). The sensory register is an extremely short lived store which holds incoming sensory information until it can be processed and transferred to the short-term store. The short-term store maintains information temporarily while it is manipulated for storage and retrieval from the long-term store. This manipulation was not conceived of as a removal of the information from one store to the other, but rather as a copying operation which does not affect the status of the material in the original store. The authors stated:

> The short-term store thus acts as a "window" upon LTS, allowing S to deal sequentially with a manageable amount of information (p. 186).

Atkinson and Shiffrin conceived of two useful purposes for such a short-term storage system. They felt that the presence of this system helps to remove the memory system from the external environment and thus protect it from constant environmental changes. They also felt that a temporary storage system provides an opportunity for the manipulation of information. Other authors have argued both for and against a two factor theory of memory (Melton, 1963; Waugh and Norman, 1965).

Clustering and Subjective Organization in Free Recall

It was reported earlier that free recall was the most valid psychological paradigm for testing awareness of redundancy. Since redundancy in language is a type of stimulus organization of which

subjects must be aware and use as a basis for their psychological organization, free recall should be a good method of examining memory organization. Neisser (1967, p. 288) stated that it should be possible to learn about the cognitive structures that facilitate recall by providing organization through observing the subject's recall and by working backwards. Mandler (1967, p. 370) has indicated that any experiment, including free recall, which uses words is tapping already existing organization for verbal material. Thus it appeared that free recall experiments using verbal materials should make accessible the subject's organizational tendencies for grouping and processing verbal materials in memory.

Empirical observations appeared to have borne out the above expectation. The typical paradigm for a free recall test involves the presentation of a list of words read at a reasonably rapid pace, the list being long enough to preclude rote learning. The subject must report immediately after the list is read all the words he can remember in any order that he wishes. This report is usually in writing (Adams, 1967, p. 153). Bousfield used the above procedure to pioneer the search for clustering in free recall.

Bousfield (1953) presented his subjects with a list of sixty nouns, fifteen each in four categories, animals, names, professions and vegetables. Using a free recall procedure, he examined the subjects' responses for what he termed "clustering". Clustering was exhibited by the tendency for words within the same category which were presented in random order throughout the entire list to be recalled in groups or clusters. Bousfield worked on the assumption that "clustering is a consequence of organization in thinking and recall (1953, p. 229)" He

believed that

> If clustering can be qualified, we are provided with a means for obtaining additional information on the nature of organization as it operates in the higher mental processes (1953, p. 229).

Bousfield analyzed the errors into two types; categorical intrusions, which could be classified in the categories of the stimulus material, and irrelevant intrusions which could not be so classified. For the purposes of scoring, categorical intrusions were treated as correct items.

The results indicated that the subjects tended to cluster their items in recall in excess of chance. Also, clustering tended to break down as the subjects approached the limits of their memory for items. Bousfield concluded that the results supported the existence of an organizational tendency in the free recall of verbal items.

Later experiments on clustering using the free recall technique found that the total amount of clustering occurring in recall was a function of the degree of reinforcement of the stimulus words as indicated by their frequency-of-usage based on the Thorndike-Lorge word count (1955) and their ability to be categorized (1958). It was also revealed that the amount of clustering increased as the categories increased from two to eight in a forty word stimulus list and that set influenced clustering (Bousfield and Cohen, 1956). Research has also indicated that if a subject can recall one word from a category there is a high probability that he will recall at least two words from that category (Cohen, 1963) thus indicating the possibility of a some-or-none feature to clustering (Cohen, 1966). In addition, it was found that clustering increased as word lists were learned to a criterion of five

consecutive errorless recalls (Bousfield, Puff and Cown, 1969). Thus clustering appeared to be well established.

Gonzalez and Cofer (1959) used the same technique as Bousfield to study clustering. They examined the role of modification on clustering using adjective-noun and adverb-verb pairs. The adjectives and adverbs were alternated either to comply with or to oppose the categorization of the nouns or verbs. In a preliminary study the researchers found a tendency for parts-of-speech to cluster (1959, p. 300). They found that adjectives which modified nouns in a way which complied with the categorization of the nouns facilitated clustering while adjectives which could themselves be clustered in a pattern different from the nouns they modified hindered clustering. The researchers stated that:

> ...contextual or modifier effects can facilitate the organization of recall shown by clustering and can hamper such organization either by the specificity of their relations to the words modified or through conflict engendered by their own clustering tendencies in relation to those of the words modified (1959, p. 306).

The results of the adverb-verb pairs were less clear. The researchers concluded that mediated clustering represented coding features rather than associative factors (1959, p. 317).

The finding that words tended to cluster on the basis of their parts-of-speech indicated above, was later denied in research by Cofer and Bruce (1965) and confirmed in research by Stanners (1969). These two pieces of research used nouns, adjectives and verbs. Thus the linguistic category of part-of-speech may or may not facilitate clustering in free recall.

An apparent weakness of Bousfield's technique for analyzing free recall protocols was that the experimenter provided the organization and the subject was to discover it. The subject may possess

idiosyncratic organizational tendencies which are not revealed by this method of analysis and thus the method may yield an underestimate of the degree of organization present. In response to this criticism, Tulving (1962) devised a method to measure the subjective organization (SO) of subjects in free recall experiments which did not rest upon experimenter selected criteria for organization. Subjects were given repeated free recall tests with the same stimulus words randomly arranged at each presentation. It was hypothesized that the extent to which the same items tended to remain in close temporal proximity to each other in the subject's recall while the order of the stimulus list was altered was a measure of the organization of the subject in the free recall of the list. It was found in experiments using this method of analysis

> ...that the subject's recall behaviour manifests such subjective organization, that this organization increases with repetition and that there is a positive correlation between organization and performance (1962, p. 270).

A later experiment by Tulving (1966) supported the hypothesis that rehearsal of a list of words is only effective in increasing recall if it permits the subject to organize the material into appropriate subjective units.

Cofer (1965), after reviewing a number of studies related to organization in free recall, attempted to pin-point the mechanism whereby clustering took place. He stated that the studies of organization fell into two groups, category clustering and associative clustering. Experimenters using category clustering attempted to explain their results by hypothesizing the existence of a superordinate mediator between responses. This was a stand taken by Bousfield in his early work

(1953). Experimenters using associative clustering explained their results by means of associative links between pairs of words (Cofer, 1965, p. 588). In addition, Tulving's subjective organization was considered to indicate the existence of idiosyncratic organizational tendencies which may be neither categorical nor associative.

A careful review of available literature and analysis of the reported results led Cofer to believe that neither associative clustering nor category clustering nor subjective organization accounted by themselves for clustering, but together they may provide a reasonable explanation.

> Subjects will, themselves, find relationships among items which will confer organization on recall. But when certain relationships among the items are prominent, as they are among categorized words and among highly associated items, the subject uses the ones provided and subjective organization falls to low levels (1965, p.270).

However, while Cofer concluded that both association and categorization were involved in clustering, a conclusion in line with that of Bousfield, Steward and Cowan(1964), he was forced to admit that it was impossible to differentiate accurately between them.

Recent work on association theory, which has emphasized the structure of patterns of inter-item associations rather than simple paired associations, may have made the differentiation between associative and category clustering less important than previously. Deese (1965) has indicated that highly related words tend to break up into conceptual clusters (p. 63). In addition, he believed that associations are derived from schematic structures which involve more than paired item association. Thus, the differentiation may not be crucial.

The concept of memory held by people who have examined organization in memory processes was not that of a passive record of past events but rather of an active recreation of events based upon stored abbreviated codes and knowledge of the patterns of regularities which can be used to expand the code. The search for organization and strategies for making information more efficient for storage involved memory processes in the cognitive life of the individual and both shaped and restricted the products of higher order though processes. This view of memory was similar to that held by Bartlett (1932) as indicated earlier.

Summary

Thus, the recent work on memory has emphasized meaningful rather than rote memory. This type of memory was considered to be a cognitive variable influencing the processing of stimuli. The role of organization was crucial to this type of memory. Organization in memory may be the psychological counterpart of organization or redundancy in natural languages.

Organization in memory processes appeared to involve recoding in a hierarchical fashion similar to the hierarchical organization of natural languages. This organization may be the factor by which the limitations of short term memory are overcome. Natural language mediators may facilitate this organization.

The role of organization in memory processes may indicate the need for the human processor to match the organization present in the stimulus if meaning is to take place, particularly with language. Ausubel has termed the organization present in symbolic systems

"logical" meaning while that which represents the stimulus in the subject was termed "psychological" meaning (1968, p. 44 - 45). For the processing of verbal material, the organizational tendencies present to permit the creation of this psychological meaning may have to correspond to the linguistic and semantic components of the language.

Free recall appeared to provide access to the organizational tendencies of the subject for the material being recalled. With verbal material it appeared possible to assess the linguistic and semantic organizational tendencies of the subject's memory processes.

IV. Organization in Memory, Recoding and Reading Comprehension

This section attempts to integrate the findings of the above theoretical discussion and utilize the results in the creation of a tentative theoretical model of the role of memory in reading comprehension. Reading is one aspect of the total package of language abilities. As such, although it may have its own unique characteristics, it shares many common features with the other language processes. One of the commonalities is the processing of symbols to obtain meaning regardless of the modality of input. Since the theoretical discussion developed previously attempted to describe at least one variable in language processing, that is, memory, it may be pertinent to the study of reading.

It would appear as though memory must be involved in reading comprehension, for, while language is sequential and moves through both time and space, the comprehension of meaning must be cumulative and involve information presented at different places on the printed page and read at different times. That is, for comprehension to take place,

it is not sufficient that the message contained in print be reconstructed as a linear language form. There must also be manipulation, re-organization and processing of the reconstructed message in order to create a representational schema of that message if comprehension is to ensue.

Since it would appear that memory is involved in some manner in reading comprehension, it would seem to follow that the nature of memory functioning would affect the nature of reading comprehension. Thus, if organization is as intimately involved in memory as previously indicated, it would seem that the ability of the reader to impose organization upon verbal symbols for storage would affect comprehension since it would, in part, affect the cumulative building up of meaning derived from the verbal symbols. If organization in memory processes is based on certain cues potentially present in the stimulus, it would appear that the ability of a reader to use pertinent cues present in a printed message for organization in memory processes would affect the nature of what is stored and comprehended. For it would appear possible that comprehension may involve the unitizing and recoding of previously comprehended and stored chunks. Storage and comprehension may then be closely interrelated.

If recoding takes place in memory processes, and if recoding involves the abstraction of informationally rich elements from a redundant environment, it would appear possible that comprehension is affected by the reader's ability to recognize redundancy and to form informationally richer codes from this redundancy. In addition, if redundancy in natural languages is of two complementary types, linguistic and semantic, it may be that the reader must attend to these two

components in recoding a language message. Thus it would appear that while memory processes are only one cognitive variable influencing reading comprehenion, the empirical analysis of the role memory plays in comprehension was germane to an understanding of the comprehension process.

The discussion of memory processes, as presented above, would appear to refer to only one aspect of the reading act. Wiener and Cromer (1967) have indicated that reading may be considered to be a two-step process involving first identification and then comprehension (1967, p. 639). Identification they took to mean "word-naming" in the context of a transformation of stimuli (1967, p. 635) while comprehension was considered to refer to the addition of some form of meaning associated with the identification (1967, p. 638). The authors stated that while it is assumed that identification comes before comprehension, comprehension may aid identification, as in the case of a cloze test (1967, p. 639 - 640). While memory may also be involved in the identification step, this research project did not intend to examine this possibility, and assumed that this process of identification has already taken place.

In addition, this research project did not attempt to explain the role of memory in such high level skills as evaluation, extrapolation of information beyond the written passage, and awareness of author's tone or intent, even though such a role may exist. This project was concerned only with the role of memory in the creation of literal meaning from a language message. Understanding of this phenomenon may not only allow explicit teaching to improve these skills, but the resulting improvement may facilitate the more advanced skills.

This research project attempted to examine the ability of readers to recode symbols, in this case isolated words, on the basis of certain selected linguistic and semantic criteria and to recall these symbols. The items used were drawn from a reading passage and the ability of subjects to comprehend this passage was assessed. An attempt was made to show the relationship between these two skills. Figure I attempted to illustrate this process diagramatically.

In addition to the specific processes which this research project attempted to examine, the generalizations developed previously allowed the creation of a tentative theoretical model of the role of memory in literal comprehension of language. This model involved the processes to be examined but went beyond them. Basically this model involved the recoding of units into a more generic code through the process of abstraction and based upon the linguistic and semantic cues of which the individual is aware and which he can utilize in his memory organization.

Thus, according to the diagram below, the identification process was assumed to have taken place. The symbols resulting from this process are then grouped into units based upon linguistic and semantic cues. The units may vary with the reader's knowledge and maturity. The resulting units are recoded by removing the linguistically and semantically redundant features. Here again, what is left behind will depend in part on the reader's knowledge of the rules of redundancy in language, both linguistic and semantic, as it is these relational rules that allow recreation of the original. In addition, there may be a limitation to recoding imposed by the individual's ability to abstract. The more generic code may be again recoded until the processes reach a sufficient level of abstractness to meet the reader's needs or until

FIGURE 1

DIAGRAMATIC REPRESENTATION OF RECODING

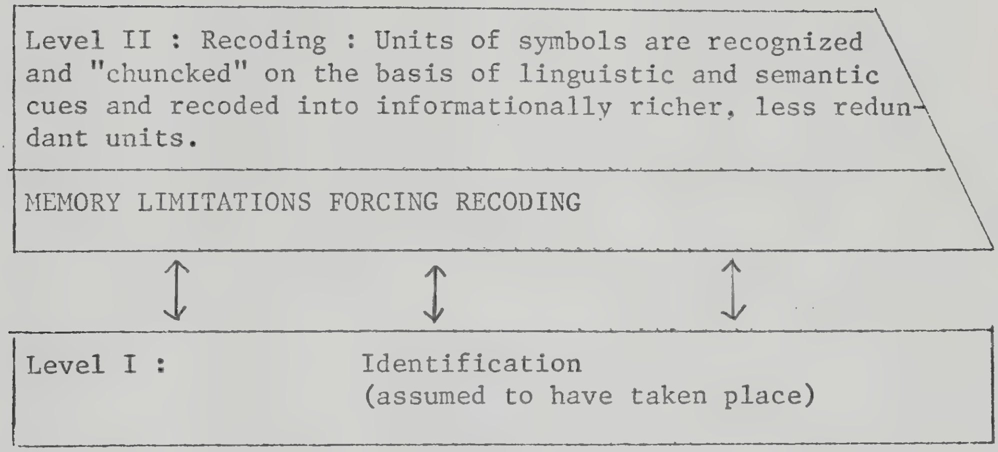
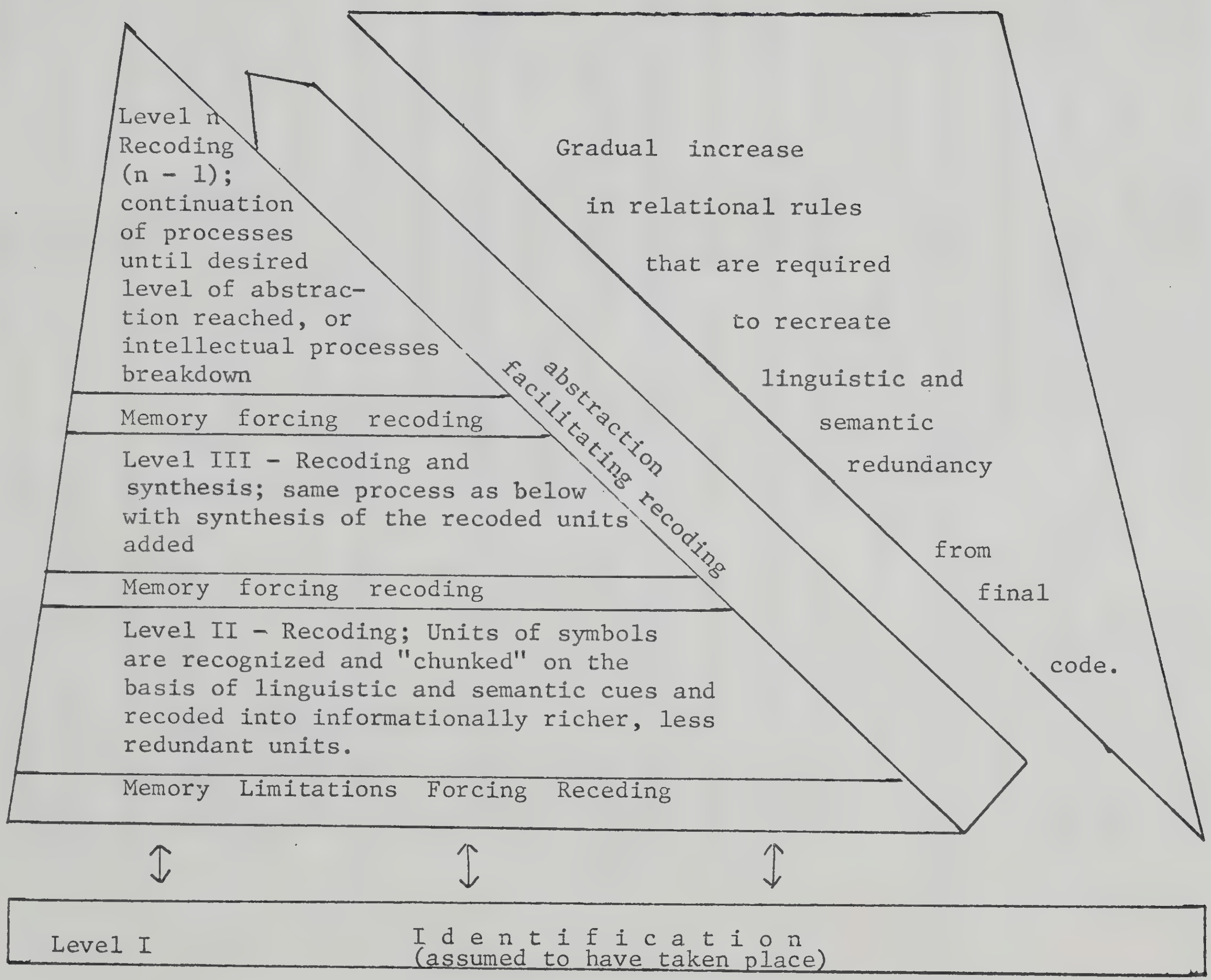


FIGURE 2

TENTATIVE MODEL OF THE ROLE OF MEMORY PROCESSES IN READING COMPREHENSION



his capacity to recode is reached. In either case, the most generic code attained is stored in long term memory, retrieved when necessary and used as a basis for reconstruction of the original, along with knowledge of the relational rules. However, the original will probably never be duplicated exactly.

The above theoretical model appeared to have certain advantages to offer. It takes into consideration the role of memory in reading comprehension, which to the present has not been stressed in reading theories. It offered partial explanation for the role of language ability in the reading act. It also offered an explanation of at least part of the elusive role of the ability to abstract in reading.

Such a model also appeared potentially to explain certain observations which have often been made by teachers of reading. It may explain why memory for read material is very inaccurate and serves as a poor base for further ideational processing. Recreation of material may involve additions, deletions, and modifications. Good readers have appeared to read not word by word but in word groups. This may be explained by the good reader's greater ability to unitize and thereby facilitate recoding and comprehension.

The above model was obviously in need of empirical testing. It appeared that the place to start such testing was with the reader's ability to select linguistic and semantic cues as a basis for organization in memory, as this is a basic ability in the model and would appear to be involved in level II in the model. Free recall appeared to offer an experimental tool capable of revealing the reader's organizational abilities and tendencies. In addition, the results have to be related to the ability of the subject to comprehend passages,

preferable containing the same cues present for free recall, to see if organization in memory does, in fact, facilitate processing for comprehension. Such experimentation, while it would not examine the entire model, would examine an ability basic to it and thereby cast light on its validity.

V. Summary

This chapter has attempted to review the literature pertaining to the role of memory processes in reading comprehension and the nature of memory processes in an effort to construct a theoretical structure which could be examined empirically. A review of the available material concerning memory involvement in reading comprehension led to the conclusion that while such involvement appeared possible it had yet to be specifically examined. A review of the theory and research concerning the recoding and unitizing hypotheses was followed by a discussion of the research into organizational processes in memory. The results of this review led to the creation of a tentative theoretical model of the role of memory processes in reading comprehension. It was this theoretical position which was examined in this research project.

CHAPTER III

THE DESIGN OF THE RESEARCH

This chapter contains a description of information pertinent to the design of the research. A brief overview of the research design is followed by a description of the population and sample. A review of the testing instruments utilized in the study precedes a discussion of the group testing schedule. A brief description of the statistical treatment of the data concludes the chapter. A more thorough analysis of the experimental testing instruments was left for the following chapter.

I. The Research Design

The main purpose of the study was to examine the relationship between organization in memory processes and reading comprehension in elementary school children. As a result, a sample of one-hundred-and fifty grade six students was used in the study. Since organization in memory processes has been examined in adult subjects, it was felt that the concept may be most applicable to the more mature elementary child.

Following the precedent set by researchers in the field of memory, for example, Bousfield (1953) and Tulving (1962), the free recall paradigm was utilized to examine organization in the memory processes of the subjects in the study. Subjects were presented with lists of words which they were instructed to remember and recall in any order that they wished. Since an attempt was made to relate performance on the free recall task with reading comprehension, the words on the lists

constructed for recall were selected from articles which subjects were asked to read and comprehend. The measure of reading comprehension utilized in the study was the cloze test. Thus subjects completed a cloze test for each of the articles from which the word lists for the free recall task had been constructed.

Three different types of word lists were constructed from each of three different articles. These three types of word lists differed in the clues for organization in memory processes which the experimenter attempted to build into each type of list. Each subject received one free recall task involving each of the three different types of lists. In addition, each subject received one delayed recall based upon one of the word lists. A delayed recall involved a second recall of the presented word list following a four minute period filled with unrelated activity.

Since the subjects were tested in class groups, each group received three cloze tests based upon three different articles and three free recall tasks based upon the same articles in addition to one delayed recall. Furthermore, in order to obtain information concerning the subjects' mental ability and reading achievement, standardized tests of mental maturity and reading achievement were administered to the subjects. Information concerning the subjects' age and sex were also collected.

II. Population and Sample

The test population for this study consisted of all those students who were in grade six in the schools of the Grande Prairie School District #2357. Grande Prairie is a small urban centre of

approximately twelve thousand people located in the north-west of the province of Alberta. At the time of the testing there were 224 students in eight grade six classes in the four elementary schools under the school board's jurisdiction.

The sample was drawn from this population in classroom groups. Six classes of grade six students were selected randomly from those available to the experimenter. All students in each class were tested. From those students who had completed all of the tasks, twenty-five were drawn randomly from each class. Figure 3 indicates the number of students in each class who completed all of the tasks. Thus, all members of a particular group belonged to a single class. Students in this particular school district were not assigned to a class on the basis of any predetermined criteria, that is, the classes were not streamed.

The utilization of a sample of subjects in the age range from eleven to fourteen years appeared to differ from other studies which have attempted to examine organization in memory processes. Only one study could be found which dealt with subjects other than adults or young adults. Rozov (1964) examined the organization in free recall of grade nine students in Russia and concluded that such organization did exist in subjects in this age group.

III. Instrumentation

Two types of instruments were utilized in the study, the experimental tests constructed by the researcher and commercially published standardized tests. An attempt was made to describe these tests, to give the reasons for their usage in the study and to indicate

FIGURE 3

NUMBER OF STUDENTS IN EACH CLASS COMPLETING ALL TASKS

	Total No.	No. Completed	No. Selected
Class I	30	29	25
Class II	30	25	25
Class III	29	28	25
Class IV	27	26	25
Class V	31	26	25
Class VI	28	25	25

their methods of administration and scoring.

Standardized Testing Instruments

Standardized Reading Achievement Test:

In order to obtain an indication of the subject's level of achievement in reading, a standardized test of reading achievement was administered. The standardized test used in the study was the Gates-MacGinitie Reading Tests, Survey D, form 2M. This form is for use with students in grades four through six and yielded three sub-scores, one each for speed and accuracy, vocabulary and comprehension.

The speed and accuracy sub-test attempts to provide "an objective measure of how rapidly students can read with understanding (Gates and MacGinitie, 1965, p. 1)". It consists of thirty-six short paragraphs of relatively uniform difficulty, each one of which ends in a question or an incomplete statement. The student must select the correct answer or completion from the four choices provided. A time limit of six minutes is imposed. Spache, in Buros (1968, p. 304), in reviewing the test, has criticized this section on the grounds that the content may be so simple that the test may yield inflated scores.

The vocabulary section attempts to "sample the student's reading vocabulary (Gates and MacGinitie, 1965, p. 1)". The test consists of fifty stimulus words each of which is followed by five possible answers. The student must select the one word that most nearly means the same as the stimulus word. The words are graduated in terms of familiarity and difficulty.

The comprehension section attempts to measure "the student's ability to read complete prose passages with understanding (Gates

and MacGinitie, 1965, p. 1)". The test consists of twenty-one passages in which a total of fifty-two blank spaces have been inserted by deleting a word. A choice of five possible completions is provided for each blank and the student must select the one word which best conforms to the meaning of the whole passage. This format differs from the cloze procedure used in this study in that the deletions are not made according to a standard formula, for example, every fifth word, and the possible answers are provided. The passages used in the comprehension section are graduated in terms of difficulty.

While both the vocabulary and comprehension tests have time limits, the authors do not consider them to be speed tests. They stated that "many students will have time to try all of the questions (Gates and MacGinitie, 1965, p. 2)".

Reviewers have criticized some features of the test. Spache (Buros, 1968, p. 303 - 304) has indicated that the instructions regarding time limits appear vague and that since the test relies heavily on inferential thinking, it may not be well related to the skills of immediate recall of details and main ideas which he appears to feel form a significant part of teacher evaluation of progress in reading. Wantman, in Buros (1968, p. 304 - 307), has criticised the test constructors for their lack of data relating to validity and has indicated that the scores are not likely to be useful for individual diagnosis. However, both reviewers felt that the reliability of sub-tests has been firmly established and Wantman has pointed out that the normative figures were based upon 23,100 cases (Buros, 1968, p. 304). Both reviewers have concluded that the test is extremely useful for determining the level of competence of groups of pupils in reading.

An attempt was made in the study to examine the relationship between the experimental measures of reading comprehension, that is, the cloze scores and the results of the standardized reading test to see if subjects' results on the cloze tests reflected their level of reading achievement, as indicated by their scores on the Gates-MacGinitie Reading Tests. In addition, an attempt was made to examine the relationship between the free recall scores of subjects and their scores on the standardized reading test.

The standardized reading test was administered to students several days after the administration of the experimental tests either by the experimenter or by an employee of the school district who had completed a graduate degree in the field of reading. The administration of the tests was carried out according to the directions in the accompanying manual of instructions for administration. All students marked their responses on computer scoring sheets which were scored by means of an optical scanner.

Standardized Test of Mental Maturity:

In order to obtain an indication of the subject's mental maturity, a standardized test of mental ability was administered. The standardized test used in this study was the California Short-Form Test of Mental Maturity, 1963 S-form, level 2. This level is designed for the interval between Primary and Junior High. This test is composed of seven subtests measuring four factors which are divided into Language and Non-Language sections.

Factor I is labelled Logical Reasoning and demands of the subject that he "apply inductive or deductive reasoning to perceive the logical response or relationship called for by the items in each test (Sullivan

et al., 1963 p. 6)". This factor is measured by three multiple-choice sub-tests of fifteen items each. The three sub-tests are Opposites, Similarities, and Analogies.

Factor II is labelled Numerical Reasoning and is considered to involve "reasoning in quantitative relationships with emphasis upon comprehension of numerical concepts and the application of mathematical principles to problem-solving (Sullivan et al., 1963, p. 6)". This factor is measured by two sub-tests. The Numerical Values sub-test is composed of fifteen multiple-coice items which test the ability of the student to manipulate numerical combinations in the form of coins. The Number Problems sub-test is composed of ten problems of quantitative reasoning presented in paragraph form.

Factor III is labelled Verbal Concepts and is measured by one sub-test, that of Verbal Comprehension. This sub-test is essentially a twenty-five item multiple-choice vocabulary test in which the student must select from four words the one that means the same as the stimulus word.

Factor IV is labelled Memory and is measured by one sub-test, that of Delayed Recall. A story is read to the group at the beginning of the test period and the final test in the booklet consists of twenty-five multiple-choice items which attempt to test retentive ability for facts or ideas stated or clearly implied in the story. The presence of this factor was one of the reasons for the selection of this particular test of mental ability for inclusion in this study. It was felt that it may be of some interest to examine the relationship between this memory score and those achieved on the experimental free recall measures of memory.

Sub-tests one through four are considered to compose a Non-language

section in which "a minimum of verbal material is presented and a particular aspect of the examinee's mental capacities is measured through items that require the recognition or logical analysis of abstract relationships (Sullivan et al., 1963, p.6)". Tests five through seven compose the Language section which is intended to "sample the ability to comprehend verbal and numerical concepts of various types, and test the extent and accuracy of recall (Sullivan et al., 1963, p. 6)".

Stanley in Buros (1965) in reviewing the test criticized the test constructors for their failure to include statistical evidence of reliability or validity in the Examiner's Manual. In addition, he questioned the Delayed Recall test on two grounds. The first was that it is difficult to get a story which is sufficiently novel so that the questions based on it cannot be answered without having heard the story. The second was that since the answering of the questions requires considerable reading, as the subject must read the questions and possible answers to himself, sheer memory may not be all that is tested (Buros, 1965, p. 444). In general, Stanley indicated that the test is very acceptable for use as a measure of mental maturity.

An attempt was made in the study to examine the relationship between the experimental measures of reading comprehension and free recall and the subject's results on the <u>California Short-Form Test of Mental Maturity</u> in order to try to ascertain the relationship of these measures to mental ability. In addition, an attempt was made to examine the relationship between the cloze test scores, free recall scores and the Delayed Recall score from the standardized test of mental maturity in order to see if the two measures of memory were related and to find out which one was the better predictor of reading comprehension.

Again, this test was administered according to the standard instructions either by the experimenter or by an employee of the school district who had completed a graduate degree in the field of reading. Students recorded their responses on computer scoring sheets and these sheets were marked by means of an optical scanner.

Experimental Testing Instruments

This section describes briefly each of the experimental tests utilized in the study and the reasons for its use. A detailed explanation of the construction, administration and scoring of these tests is given in Chapter IV.

Cloze Tests:

In order to examine the subject's ability to read and comprehend a written article, the cloze procedure was utilized. This procedure involved the mutilation of a passage by the deletion of every fifth word. The deleted word was replaced by a standard sized blank. The subject was required to read the passage and fill in the required word. The subject's score was derived by counting the number of words which the subject was able to replace. A cloze test was constructed in the above manner for each of the three passages used in the study.

The subject's score on the cloze test was considered to reflect his ability to read and comprehend the passage upon which the cloze test was based. This score was used in the study as the criterion score which the free recall scores were required to predict.

Free Recall Tasks:

In order to examine the subject's organization in memory processes, the free recall paradigm was used. According to this procedure

the subject was presented with a list of words which was too long to be remembered by rote following a single presentation. The subject was asked to recall as many words as he could, in any order that they occured to him, following the presentation of the list.

Three different types of free recall lists were constructed from the words contained in each article. Each subject was required to recall one of these lists for each article. Since the subject recalled a different type of list for each of the articles, each received all three different types of free recall lists.

The scores derived from the free recall tasks were considered to reflect the subject's memory abilities and particularly his organization in memory processes. These scores were used to predict the subject's reading comprehension ability as reflected by his cloze scores.

IV. Group Testing Schedule

In order to control for the possible order effect involving the administration of the cloze and free recall tasks, half of the sample, groups I to III, received the free recall task first and the cloze task next. The other half of the sample, groups IV to VI, received the cloze test first and the free recall tasks next. In order to control for a possible practice effect resulting from the order in which the three different free recall tasks were administered, this order was varied for the different groups. It was varied consistently so that each of the different types of recall tests occurred twice in each of the three possible positions, initial, medial and final. It was hoped in this way to control experimentally for these two possible order effects. Figure 4 outlines the testing format. The symbols SOL, LOL and ROL

FIGURE 4

GROUP TESTING FORMAT

Group	Article I	Article II	Article III
I	SOL cloze	LOL cloze	ROL-delayed cloze
II	LOL cloze	ROL cloze	SOL-delayed cloze
III	ROL cloze	SOL cloze	LOL-delayed cloze
IV	cloze SOL	cloze LOL	cloze ROL delayed
V	cloze LOL	cloze ROL	cloze SOL-delayed
VI	cloze ROL	cloze SOL	cloze LOL-delayed

Key : SOL = semantically organized list
LOL = linguistically organized list
ROL = randomly organized list

stand for the three different types of free recall lists. The differences between these lists will be explained in detail in Chapter IV.

As Figure 4 indicates, each group received three free recall tests and three cloze tests on three different articles. Each group received one of each of the three different types of free recall tasks but because of the variation only two groups received the same type of recall task for the same article and these two groups received the cloze and recall tasks in different orders. Furthermore, each group received one delayed recall task based upon Article III in addition to the first three free recall tasks. The reasons for the delayed task are made explicit in the following chapter when the pilot study is described and discussed.

V. Treatment of the Data

In order to examine the hypotheses set forth previously, the following statistical procedures were undertaken at the Division of Educational Research Services at the University of Alberta employing the IBM 7040 computer.

Computation of Correlations

A variety of correlation coefficients were calculated. These included correlations examining the inter-relationships of the scores achieved on the three cloze tests, as well as the relationships between the free recall results and the results of the standardized tests of reading achievement and mental maturity. Correlation coefficients were also calculated between the free recall results and the cloze test scores for each of the three articles for each of the groups in the

study. The results of the standardized test of Delayed Recall were correlated with the results of the measures of reading employed in the study. In addition, Spearmen rank order correlations were computed between the results of the immediate and the delayed free recall tasks utilized in the pilot study.

Z Tests of the Variance of Proportions

In order to examine the possibility of significant differences between the proportion of girls in each group included in the sample, Z tests of the variance of proportions were calculated. Z tests were also employed to examine possible differences in the percentage correct for each of the cloze tests as well as to test the variance of proportions based upon the correlation coefficients between the free recall results and the cloze test results among the three different articles used in the study and among the six different groups.

Multiple Linear Regression

Multiple linear regression analysis was utilized frequently in this study. This method of analysis was used to examine the relationship between performance on the free recall tasks and the combined cloze scores of the total sample. The same relationship was examined by means of multiple linear regression with consideration given to the variables of age, sex, reading achievement and mental maturity. Multiple linear regression equations were written examining the relationships between performance on the cloze tests and the variables of age, sex, reading achievement and mental maturity. The relationship between performance on the free recall tasks and the variables of sex and age was also

examined by means of multiple linear regression. The relationship between the results of the alternate scoring for the SOL task based upon Article II and the cloze test results of Groups III and VI was examined by means of multiple linear regression as was the relationship between the results of the delayed free recall tasks and the cloze test scores. In addition, multiple linear regression equations were written examining the relationship between the free recall results and the standardized memory test scores as well as the relationship between the measures of performance on the free recall tasks.

Stepwise Regression Analysis

This form of analysis indicated how well each of the measures of performance on the three types of free recall tasks predicted the combined cloze scores of the total sample.

Analysis of Variance

The Newman-Keuls test of comparison between ordered means was used to examine possible differences between the groups on the variables of age, reading achievement, mental maturity and cloze test scores. One way analysis of variance was used to examine the variance between Group III and the remainder of the sample on the same variables as above. Finally, a one way analysis of variance was employed to examine differences in the N scores for the three types of free recall tasks.

In addition to the above forms of analysis, means and standard deviations were calculated for a number of variables and the Arrington formula was used to compute the inter-scorer reliability for the classification of the words on the semantic free recall lists.

VI. Summary

This chapter has presented an overview of the experimental design followed by a description of the population and sample. A description of the standardized testing instruments and an explanation of the reasons for their usage and their pertinence to the study followed. A brief description of the experimental tests preceded a discussion of the reasons for the group testing format. The chapter ended with a discussion of the statistical treatment of the data.

CHAPTER IV

THE CONSTRUCTION OF THE EXPERIMENTAL INSTRUMENTS

This chapter describes the construction of the experimental instruments. A statement of the reasons for the inclusion of each of the tasks in the experiment is followed by a description of the construction of the instrument, its pertinence to the study and its method of administration and scoring. A description of the pilot study and the results pertinent to the experimental instruments concludes the chapter.

I. The Construction of the Cloze Tests

In order to obtain an indication of the subjects' ability to read and comprehend written articles, the cloze procedure was utilized. As stated previously, this procedure involved the deletion of every fifth word from the article. The cloze procedure has been found to be a valid and reliable means of measuring reading comprehension (Jenkinson, 1957; Fletcher, 1959; Hafner, 1965; Weaver, 1965).

Selections of reading material for children were surveyed in an attempt to find articles which would be suitable for the construction of cloze tests. Six articles were found which appeared to be potentially interesting to both sexes and appeared to be of suitable length. These articles ranged from approximately six-hundred to eleven-hundred words in length. The Dale-Chall readability formula (Dale and Chall, 1948) was used to give an indication of the level of reading difficulty of the passages. The results, as indicated in Table I, showed that the six

articles ranged from upper grade four to middle grade five level in difficulty or approximately three-quarters to one and one half years below the grade level of the sample.

Table I

DALE-CHALL READABILITY SCORES FOR ARTICLES

Article	Length in Words	Grade Level of First 100 Words	Grade Level of Last 100 Words
A	1090	Gd.5.34	Gd.4.82
B	1065	5.07	5.49
C	757	4.01	5.24
D	606	5.99	5.44
E	832	5.80	4.76
F	1140	5.63	5.49

Each of the six articles was mutilated by the deletion of every fifth word. The articles were typed onto stencils with standard sized blanks replacing the deleted words. The articles were reproduced and, as described in a later section, their suitability for the major study was evaluated in a pilot study. Three of the six articles were selected, articles C, D and E in the above table.

All cloze tests were adminstered by the experimenter according to a standard set of instructions contained in Appendix A. Time limits were set which on the basis of experienced gained from the pilot study appeared reasonably lenient. Following the completion of each of the cloze tests all copies of the material were collected.

All cloze tests were scored by the experimenter. Each response was marked either right or wrong. Only exact replications of the word

used by the author were considered to be acceptable. However, spelling errors were ignored as long as the word was recognizable. The correct answers were tallied for each test.

The accuracy of scoring for the cloze tests was checked by an additional marker who had completed a graduate degree in the field of reading and who was familiar with the cloze procedure. This marker re-scored 151 of the cloze tests, or approximately thirty percent. Of the tests that were re-scored, only thirteen test results differed from the original mark assigned and in no case was the difference more than one point resulting from a difference in the scoring of one blank. As a result, it was felt that the accuracy of scoring for the cloze tests was acceptable.

The scores derived from the cloze tests for each subject were considered to be an indication of the ability of the subject to read and comprehend the passage upon which the cloze test was based. This score was used as a criterion measure with the free recall scores as predictors in the statistical analysis described later.

II. The Construction of the Free Recall Tests

In order to obtain an indication of the subject's organization in memory processes, the free recall technique was used. This procedure has been used extensively in the past (Bousfield, 1953; Tulving, 1962) and is considered to the most valid measure of a subject's ability to utilize redundancy in memory (Garner, 1962, p. 167).

The free recall procedure involved the presentation of a list of words to the subject at a fairly rapid pace. The subject was instructed to remember as many of the words as he could in any order that he was able.

In order to construct the free recall tasks for this study, lists of words were selected from each of the articles used in the study according to certain pre-determined criteria. The selection of words from a restricted pool of words, that is, those present in the written articles, represented an innovation from the previous experiments concerned with organization in free recall. The usual procedure had been to select words according to certain pre-determined criteria from virtually an unrestricted pool of available words.

Three different types of lists were constructed. These lists differed in the criteria used for the selection of the items. A Semantically Organized List, which was referred to as SOL, was composed of words selected according to their membership in conceptual or semantic categories. For example, the words "waves", "tossing", "ocean", "sea", and "calm" were selected from a single article and were considered to belong together within a conceptual or semantic category which may possibly be loosely labelled as "pertaining to large bodies of water".

A Linguistically Organized List, which was referred to as LOL, was composed of words selected from a single article and organized according to their membership in a part-of-speech category. The part-of-speech categories used were those of noun, verb, adjective, adverb and connective. In applying the criteria of part-of-speech to the selection of words in isolation, the difficulty arose that very often isolated words could conceivably belong to two or more part-of-speech categories. This difficulty was particularly true of adjectives and adverbs. However, an attempt was made to include words which appeared to be commonly associated with one part-of-speech category.

The division of the above two types of lists into a semantic and a linguistic list should not be conceived of as a rigid and comprehensive division. Words in the semantic list did belong to part-of-speech categories which may have provided clues for organization in memory processes. Words in the linguistic lists did belong to conceptual or semantic categories which may have provided clues to their organization. However, since the two types of lists were constructed according to different criteria, it was expected that one would be primarily or more readily organized in memory processes according to one criterion and one by the other. An analysis of the results, as indicated later, appeared to uphold the distinction between the two types of lists.

A Randomly Organized List, which was referred to as ROL, was composed of words selected from a single article by means of a table of random numbers. Each word was assigned a number and twenty-five words were selected on that basis. A qualification was that no word could appear more than once on a single list. Thus the ROL lists possessed no basis for organization in memory processes that was known to the experimenter.

Each of the three types of lists was selected for a specific reason. As has been indicated (Miller and Isard, 1963; Mark and Miller, 1964) individuals appeared to be able to utilize both linguistic and semantic redundancy in processing stimuli. In addition, subjects appeared to exhibit organization in memory processes on the basis of conceptual categories (Bousfield, 1953; Gonzalez and Cofer, 1959) and the linguistic category of parts-of-speech (Gonzalez and Cofer, 1959; Stanner, 1969). Consequently, conceptual categories were considered

to be one example of a semantic basis of organization in memory processes and part-of-speech categories as one example of a linguistic basis for organization in memory processes. These two bases appeared to be compatible with the potentialities present in written language for organization in memory processes. The randomly organized list, in which no pre-determined criteria was used for the selection of the items, was considered to serve as a comparison to the other two potential basis for organization in memory processes.

Each list was composed of twenty-five items arranged in order according to a table of random numbers. The SOL and LOL lists were composed of five categories of five words each. This five-by-five format was chosen on the basis of research by Mandler (1967, p. 367). He suggested that lists of approximately twenty-five words containing five categories with five examplars each required only one recoding operation and were an easy task for his sample of undergraduate students. This task should therefore be sufficiently difficult for elementary school children and also provide sufficient opportunity for subjects to reveal organizational tendencies in the free recall of the lists.

All of the words included in the lists were checked for frequency-of-usage according to the Thorndike-Lorge word list (1944) as this has been shown to affect organization in recall (Bousfield and Cohen, 1955). No attempt was made to equate lists on the basis of frequency-of-usage of their items, however, rare words were deleted from the lists and replaced by more common words. Few words had to be deleted due to their rarity, possibly because the words for the articles had already been screened in order to avoid creating difficulties for young readers.

Reliability of Categorization

The possibility existed that the categorization of the words in the semantically organized lists was idiosyncratic and therefore did not provide a realistic basis for organization in memory processes. In an attempt to assess this possibility, a panel of judges was asked to classify the words selected for the lists, and the extent of agreement between the experimenter and the judges was calculated.

Five adult judges, all of whom were naive to the purposes of the experiment, were asked to place the words in categories, grouping those words together which appeared to belong together. No indication was given of a possible basis for categorization. Each word was written on a separate card and the cards were mixed before presentation to a judge. A record was kept of the classification scheme of each judge.

The Arrington formula was used to compute the extent of agreement between the classification schemes of the judges and of the experimenter. This formula is computed as follows (Feifel and Lorge, 1950):

$$\frac{2 \text{ X agreements}}{2 \text{ X agreements plus disagreements}}$$

The percentage of agreement for each of the articles selected for the final experiment is reported in Table II.

The analysis of the classification schemes of the judges for Article II, "The Stonecutter", revealed two possible schemes of classification for the words in the list. That is, a number of words, three in total, were classified by some judges within categories other than

Table II

INTER-SCORER AGREEMENT IN THE CLASSIFICATION
OF ITEMS IN THE SEMANTICALLY ORGANIZED LISTS

	Article	Percentage of Agreement
I	The Air Around Us	94.7%
II	The Stonecutter	92.4%
III	The North That Never Was	98.2%

those of the experimenter. However, there was a fairly high degree of consistency in the differences in the classification of these words. For example, the word "beams" had been classified by the experimenter in the category with the words "sun", "shone", "fierce" and "burning". However, two of the judges classified it in the category containing the words "stone", "chisel", "blocks", "rocks" and "hammer".

Two possibilities appeared to exist. The story could have been removed from the experiment or the subjects' responses to the semantic free recall task for this particular article could have been analyzed for organization in free recall using both possible classifications. Since it was felt that this story may not be atypical the latter possibility was accepted. The percentage of agreement using the revised scheme increased to 94.7%.

The high degree of consensus in the classification of the words on the semantic lists may indicate that it was not unrealistic to expect subjects to be aware of the possibility of classifying the words in this manner. Such an awareness would be necessary but not sufficient

for organization in memory processes to take place.

Administration of the Free Recall Tasks

All of the free recall tasks were administered by the experimenter according to the standard set of instructions included in Appendix A. The free recall and cloze tests were administered to each group on the same day and took approximately two and one-half hours of class time for each group. Where possible, the session was split into two parts for each group. That is, Group A worked from the beginning of the school day until morning recess after which the experimenter went to Group B. The afternoon schedule was split in a similar fashion. Two classes in schools where only one class was being tested received all of the tests in the morning. However, these classes did receive a fifteen minute break for morning recess. All classes appeared to find the cloze and free recall tasks difficult and appeared fatigued at the end of the testing session.

Each of the lists was presented to the groups both visually and orally. The reason for this procedure is explained in a later section dealing with the pilot study. An overhead projector with a special fitted frame which revealed one word at a time was used to present the words visually on a screen. As the words appeared on the screen, the experimenter spoke each word in a clear, loud voice free from undue inflection. The words were exposed at the rate of approximately one word every two seconds.

Following a two second pause after the presentation of the last word, the subjects were instructed to begin writing down as many words as they could remember in their prepared answer booklets. This booklet

contained a separate page for each written task. A stop watch was used to time the four minute recall period.

Scoring of the Free Recall Tasks

Each recall of an SOL or an LOL list was scored for three factors. The first score, N, was simply the number of words recalled correctly. The second score, R, was the number of correctly recalled items from the same category occurring contiguously. This score was derived by adding all of the words correctly recalled from a single category which followed consecutively in a subject's free recall protocol, subtracting one, and adding all such scores for a free recall protocol. For example, if the letters, a, b, c, and d stand for four categories in a free recall list and a recall protocol exhibited items arranged as follows:

a, b, b, b, c, c, d, a, a, a,

the R score would be two plus one plus two for a total of five.

The third score, RR or ratio of repetition, was a comparison of the number of words recalled in clusters with the total number of words correctly recalled. The formula for this measure is as follows:

$$RR = \frac{R}{N-1}$$

where R is the number of words recalled in clusters and N is the total number of words correctly recalled. These three measures of performance on a free recall task were first utilized by Bousfield (1953) and appeared to have remained standard measures since.

The ROL lists were scored only for the N measure. Since the other

measures required knowledge of the organization present in the stimulus list, and since the ROL lists were deliberately constructed to exhibit no scheme of organization known to the experimenter, it was impossible to utilize either the R or RR measure.

Each of the three measures, the N, R and RR scores, would appear potentially to measure different aspects of the subject's performance on a free recall task, even though Bousfield has never made explicit this differentiation. The N measure may be considered as a summary score of the subject's total performance. It indicates numerically the degree of success of the subject in recalling the material. However, it has been shown that as organization increases, the total number of words recalled also increases (Bousfield, 1953; Tulving, 1962). Consequently, the N score may involve an organization factor in addition to whatever other factors may be involved in memory performance. The R measure would appear to be indicative of the gross amount of organization present in the recall of the subject. The RR measure would appear to indicate a ratio of the amount remembered to the amount of organization in memory processes thus comparing organization present with total performance.

All three types of lists were scored for the number of errors present in recall (Etot.). The SOL recall protocols were scored for two types of errors, categorical errors (Ec.) and irrelevant errors (Ei.) following a precedent set by Bousfield (1953). Categorical errors were incorrect responses which could be classified as belonging to one of the categories present in the stimulus list. Irrelevant errors could not be so classified. The ROL lists could not be analyzed in this manner since there were no categories known to the experimenter in the lists.

The LOL lists were not scored for the categorical errors since it appeared that the probability of an error in the recall of an LOL list falling into one of the five part-of-speech categories by sheer chance was too great to allow any interpretation of categorical error scores.

In addition, the SOL and LOL recall protocols were scored for the number of clusters of from two to five words each. That is, each example of a categorical cluster of from two to five words was tabulated according to the number of items it contained. Thus, in the example of a possible recall protocol provided earlier, there would be one cluster of two items and two clusters of three items and no clusters of four or five items. These scores were called cluster scores.

The various scores derived from the free recall tasks for each of the subjects were considered to be indicative of the subject's memory performance. These scores were used as predictors of the subjects ability to read and comprehend as measured by the cloze procedure in the statistical analysis reported in a later section.

III. The Construction of the Filled Association Task

An experiment by Gonzalez and Cofer (1959) examined the relationship between the immediate recall of a word list and a recall of the same list after an interval of time and found some differences in the results. Due to this finding and the results of the pilot study reported in a later section, it was decided to include a delayed recall component in this study. The interval between the immediate and the delayed recall in the experiment by Gonzalez and Cofer was filled with a verbal task considered to be relatively unrelated to the free recall task. Subjects were read a list of words which was carefully selected

to avoid close associates of the words on the original list and were asked to write down the first word or associate that came into their minds. This task was designed to prevent rehearsal of the items in the original list. Following the example of Gonzalez and Cofer, the experimenter presented subjects with an association task between the immediate and the delayed recall of the word list in this study.

It was necessary to construct a stimulus list of words which would avoid, as much as possible, interference with the material already presented for recall. In order to accomplish this, words were selected from the Palermo and Jenkins (1964) list of words and their common associates at different grade levels. Words were selected which did not appear on the free recall lists, nor did their common associates at the grade six level. The resulting Filled Association Task may be found in Appendix D.

The filled association task was administered to each of the groups prior to their delayed recall task. The standard set of instructions, as contained in Appendix A, was read to the group and any questions were answered. This list was then read to the group at a moderate pace. The interval task was rigidly timed by a stop watch and occupied four minutes. At the end of the four minutes, the group was immediately instructed to turn the page of their answer booklets and recall as many items from the original word list as they could. The delayed recall also occupied four minutes.

IV. The Pilot Study

A pilot study was conducted in November of 1969. The purposes of this pilot study were to select from the six articles three that

appeared suitable for the final study; to examine the differences, if any, between the performance on an immediate and a delayed recall of the same word list; to examine the possibility and desirability of presenting the words both visually and orally for the free recall tasks; to examine subjects' awareness of their own memory processes as revealed by retrospection for indications of organizational tendencies or strategies; to ascertain time requirements for the testing instruments; and, to practice the administration and scoring of the tests. A discussion of the pilot study and the results follows.

Design

Six groups of ten students each from one public school in Edmonton, Alberta, were utilized in the pilot study. Fifty-four of the subjects were in grade six while six of the subjects were considered to be "top" grade five students.

Two different treatments were employed in the pilot study. Groups I through III each received one cloze test based on a different article and all three recall lists for that article. In addition, each group received a delayed SOL recall task. This pattern is illustrated in Figure 5, page 86.

Groups IV through VI each wrote cloze tests for the three remaining articles. They also received one type of free recall task based upon each of the articles. Each group received a different type of recall task so that all three recall tasks for each article were administered once. In addition the appropriate recall task for Article F was presented both visually and orally. This pattern is illustrated in Figure 6.

FIGURE 5

DESIGN FOR PILOT STUDY : GROUPS I TO III

Group	Article	Tasks
I	A	SOL-delayed SOL-LOL-ROL-Cloze test
II	B	SOL-delayed SOL-LOL-ROL-Cloze test
III	C	SOL-delayed SOL-LOL-ROL-Cloze test

FIGURE 6

DESIGN FOR PILOT STUDY : GROUPS IV TO VI

Group	Tasks
IV	SOL-Cloze Article D-SOL-Cloze Article E-SOL-Cloze Art.F
V	LOL-Cloze Article D-LOL-Cloze Article E-LOL-Cloze Art.F
VI	ROL-Cloze Article D-ROL-Cloze Article E ROL-Cloze Art.F

The purpose for varying the design was to examine both patterns as possible alternatives for the major study. In addition to the tasks indicated above, some students were asked to answer in writing a question pertaining to the method they used to remember and recall the words presented while some children were interviewed orally to obtain the same information.

Procedures

After each group was settled in a classroom provided for the testing, it was explained that this was to be an experiment to see how children learn in schools and that the tasks which they were to perform would not be used to evaluate their school progress. Student answer booklets were distributed. These consisted of a separate page for each written task. The students wrote their names on all pages at this time.

The instructions for the free recall task were read and any questions were answered. The first free recall list was read at the rate of approximately two seconds per word in a clear, loud voice free of undue inflection. Four minutes were given for the written recall, following which the students were asked to turn to the next page in their booklets.

Where applicable, that is, where a delayed recall task was to be given, the filled association task was administered. The students were read the instructions and any questions were answered. The words were read and the students wrote their responses in their booklets. The total time for this activity was four minutes. Students then turned to a new page in their booklets and another four minute delayed recall was

undertaken for the original list.

Instructions for the cloze test were read aloud and an example was worked out on the board. Any remaining questions were answered. Students were then asked to complete the cloze test. No time limit was set, but students were asked to record their times on the paper. Unfortunately, unlimited time allotments were not always possible due to the natural breaks in the school day such as lunch and recess.

The cycle was repeated for the appropriate tasks for each group. On each occasion the instructions were re-read before each task and any remaining questions were answered.

Scoring of the Data

The cloze responses were scored either right or wrong and the percentage correct was calculated. The number of words correctly recalled for each recall test (N) was tabulated. The number of correct items from the same category recalled in clusters (R) was counted and the ratio of repetition (RR) was calculated according to the appropriate formula. In addition, the written answers to the question concerning the subject's retrospective awarenes of his memory processes were carefully read.

Results

a) Selection of Articles:

The information obtained for each article is summarized in Table III. It must be remembered that not all measures based on different articles were obtained from the same or equated groups. Consequently, the data were only indicative.

Table III

SUMMARY OF RESULTS OF PILOT STUDY

Article	Free Recall Results										Cloze Test Results	
	SOL						LOL			ROL		
	Immediate			Delayed								
	N	R	RR	N	R	RR	N	R	RR	N	No.	%age
A	7.3	1.3	.20	6.2	1.5	.30	6.3	1.2	.22	6.1	58.0	26.7%
B	7.3	1.4	.24	4.4	1.0	.36	7.5	0.8	.10	5.8	67.5	31.5%
C	11.6	3.2	.29	10.3	3.1	.33	5.4	1.1	.20	7.4	63.3	38.0%
D	8.1	1.6	.19	-	-	-	6.6	1.0	.17	6.0	58.4	48.1%
E	7.5	2.4	.37	-	-	-	5.2	0.5	.10	5.8	63.7	37.0%
F	7.8	1.5	.19	-	-	-	7.7	0.7	.10	5.7	58.5	30.2%

The selection of the articles for the main study was made on the basis of a consideration of factors such as length of time required to complete the cloze test based upon the article, difficulty of the cloze test, and the performance of subjects on the free recall tasks based upon the article. From Table I it may be seen that Articles C, D and E were the shortest articles in length and it was found that they were completed more quickly by subjects in the pilot study. The cloze tests based upon Articles C, D and E appeared to be less difficult than those based upon the other articles but they still provided a challenge for able students as indicated by the percentage correct reported in Table III. Furthermore the performance of the subjects on the free recall tasks based upon Articles C, D and E appeared to be as good as or better than the performance of subjects on the free recall tasks based upon the other articles. Consequently Articles C, D and E were selected for the major study.

b) Immediate and Delayed Recall Tasks:

Table IV presents the Spearman rank order correlations between the scores achieved on an immediate and a delayed SOL free recall task for each of the measures of performance and for each of the groups that undertook a delayed recall task. Although the results were not completely consistent, the presence of several low correlation coefficients indicated the possibility that there may have been differences between performances on the two tasks. As a result, it was decided to include a delayed recall task for each of the groups in the major study.

c) Audio-Visual Presentation:

The addition of the visual component to the method of presentation did not appear to facilitate recall of the word lists for Article F, as indicated by the results reported in Table III. However, an analysis of the free recall protocols indicated that homonyms presented an unexpected difficulty. Students would, on occasion, recall "witch" for "which" and this type of misinterpretation would probably interfere with any organization which was taking place in memory processes. It was felt that if the students could see the words and their spellings that this might lessen the problem. Consequently, it was decided to present the words both visually and orally in the major study. The words were presented visually by means of an overhead projector equipped with a fitted screen which revealed one word at a time.

d) Retrospective Awareness of Memory Processes:

As a result of having children both write and talk about the ways in which they attempted to remember the words, it was felt that children at this age level were either not aware of their own memory processes and/or were not able to verbalize their awareness in a form which

Table IV

CORRELATION COEFFICIENTS BETWEEN IMMEDIATE AND DELAYED RECALL IN PILOT STUDY

Group	Article	Measure	Correlation Coefficient
I	A	N	.879**
I	A	R	.800**
I	A	RR	.664*
II	B	N	.762**
II	B	R	.588*
II	B	RR	.405
III	C	N	.902**
III	C	R	.519
III	C	RR	.013

** $p < .01$
* $p < .05$

provided any useful information. Consequently, it was decided not to undertake a retrospective task in the major study.

e) Administration and Scoring of the Test:

The instructions given to students in the pilot study appeared to be satisfactory in general. As a result, with one or two minor additions, they were utilized in the major study. The final instructions may be found in Appendix A.

Scoring techniques appeared to be generally satisfactory. However, criteria had to be established for accepting a recall item as correct. In general principle it was decided to accept a close approximation to the actual item so long as the modification did not interfere with a category present in an SOL or an LOL list. For example, if the item

on the list was "playing" and "played" was recalled, it would be acceptable. However, if "players" was recalled and the original item was in a verb category of an LOL list, the recalled item would be unacceptable.

f) Modification of the Free Recall Lists:

As a result of marking and analyzing the free recall protocols of subjects, several words were noted which appeared to act as distractors. Because these words could have belonged to more than one category present in the list, they seemed to confuse subjects. These few words were replaced for the major study. The total number of words so modified for all of the free recall lists used in the major study was four.

In summary, the findings of the pilot study resulted in the following decisions being made concerning the major study. It was decided to include a delayed recall task for each group and to present the stimulus words both visually and orally. The retrospective task did not appear to yield relevant data and so was not included in the major study. In addition, the three articles to be used in the major study were selected and minor modifications were made to the free recall lists based upon those articles.

V. Summary

This chapter has attempted to explain in detail the construction of the experimental instruments utilized in the study. In addition, a description was given of the pilot study and the resulting modifications in both the design of the experiment and in the testing instruments.

CHAPTER V

CHARACTERISTICS OF THE SAMPLE

The sample of subjects was chosen in class groups from those available to the researcher. Twenty-five students in six grade six classrooms who had completed all of the tasks were included in the sample. This chapter describes the characteristics of the sample in terms of the variables of age, sex, mental maturity and reading achievement. Furthermore, the possibility of significant differences between the individual groups on factors that could be pertinent to the question explored in this study is also examined.

I. Age of the Subjects

As Table V indicates, the mean age of students in the total sample was approximately eleven years and seven months. The mean ages for the individual groups ranged from approximately eleven years and five months to eleven years and eight months. The age range for the total sample was from ten years and eleven months to thirteen years and two months.

Table V

AGE IN MONTHS

	Groups I	II	III	IV	V	VI	Total
Mean	139.16	140.28	140.68	138.52	138.84	139.88	139.56
S.D.	3.85	7.95	6.55	4.97	5.47	6.86	6.14
Range	132-148	132-158	131-156	131-152	131-152	131-157	131-158

Thus the age range was relatively restricted as may be expected of a sample of subjects selected from a single grade level.

II. Sex of the Subjects

The number of male and female subjects in the total sample and in each of the individual groups is reported in Table VI. There were more male than female subjects in the total sample and in Groups I, II, IV and VI. A Z test of the variance of proportions indicated that in no case was the proportion of girls in a single group significantly different from any other group, the highest Z value being 0.851.

Table VI

NUMBER OF MALES AND FEMALES IN SAMPLE

	Groups						
	I	II	III	IV	V	VI	Total
Males	15	15	12	15	12	14	83
Females	10	10	13	10	13	11	67

III. Mental Maturity

The mean scores and standard deviations for the total sample and for each of the groups on the <u>California Test of Mental Maturity</u> is reported in Table VII. The results are reported for the Non-Language and Language sub-sections, the Memory sub-test and the Total score.

In order to obtain some indication of the performance of the sample relative to the population upon which the test of mental maturity was

Table VII

SUMMARY OF SCORES FOR TEST OF MENTAL MATURITY

		Groups						
		I	II	III	IV	V	VI	Total
Non-Lang.	Mn.	41.84	40.44	42.00	41.20	43.60	40.84	41.65
	S.D.	6.04	7.73	7.98	6.68	5.27	7.28	6.97
Lang.	Mn.	45.40	41.36	38.00	40.56	44.32	42.64	42.05
	S.D.	12.33	8.10	9.66	8.48	5.86	8.83	9.41
Memory	Mn.	16.72	15.80	13.12	15.12	16.64	16.00	15.57
	S.D.	3.79	4.46	4.83	3.34	3.01	3.68	4.09
Total	Mn.	85.36	81.80	80.00	81.76	88.40	83.08	83.40
	S.D.	11.08	14.20	16.79	12.65	8.59	14.18	13.46

standardized, intelligence quotients were derived from the mean Total scores for the total sample and for each of the groups. The intelligence quotient corresponding to the mean Total score for the total sample was approximately 106 while the intelligence quotients derived from the mean Total scores for each of the groups ranged from 103 for Groups III to 111 for Group V. Thus the mean scores for the total group and the individual groups would appear to fall close to the mean for the population upon which the test of mental maturity was standardized. In addition, the mean total scores for the individual groups did not appear to vary greatly one from another.

In order to obtain some indication of the performance of the sample on the Non-language and Language sub-sections, as well as the Memory sub-test, relative to the population upon which the norms for the <u>California Test of Mental Maturity</u> were based, the mean scores for

the total sample and for each of the groups on each of these three tests were converted to percentiles. The percentile corresponding to the mean score for the total sample on the Non-language sub-section was the 62nd. The percentiles corresponding to the mean scores for each of the groups on the Non-language sub-section ranged from the 73rd. percentile for Group V to the 58th percentile for Groups II and VI. The percentile corresponding to the mean score for the total sample on the Language sub-section was the 66th while the percentiles corresponding to the mean scores for each of the groups for the same sub-section ranged from the 54th percentile for Group III to the 76th percentile for Group I. Thus it would appear that the performance of the sample on the Non-language and Language sub-sections of the California Test of Mental Maturity, as indicated by the percentile ranks corresponding to the mean scores for the total sample and each of the groups, would fall into the second quartile of the population upon which the test was standardized.

The percentile corresponding to the mean score for the total sample on the Memory sub-test was the 50th. The percentiles corresponding to the mean scores for the groups on the Memory sub-test ranged from the 62nd percentile for Groups I and V to the 31st percentile for Group III. The second lowest percentile was the 46th for Group IV, thus indicating the possibility that Group III may have scored significantly lower than the other groups on this sub-test. Thus the performance of the total sample on the Memory sub-test, as indicated by the percentiles corresponding to the mean scores and relative to the population upon which the test was standardized, tended to cluster around the 50th percentile with the exception of Group III which was somewhat lower.

IV. Reading Achievement

The mean scores and standard deviations for the total sample and for each of the groups on the Gates-MacGinitie Reading Test are reported in Table VIII. The results are given for the Speech and Accuracy, Vocabulary and Comprehension sections.

Table VIII

SUMMARY OF SCORES FOR STANDARDIZED READING TEST

		Groups						
		I	II	III	IV	V	VI	Total
Speed	Mn.	16.40	17.28	19.24	19.56	17.28	21.36	18.52
	S.D.	5.15	5.70	5.66	6.09	3.98	7.98	6.12
Vocab.	Mn.	35.04	35.76	34.00	36.00	38.88	37.72	36.23
	S.D.	6.09	6.30	7.18	7.73	11.83	7.67	8.19
Comp.	Mn.	41.96	41.12	38.04	40.04	42.96	40.88	40.83
	S.D.	6.49	7.75	8.99	9.65	6.06	8.43	8.15

In order to obtain some indication of the performance of the total sample and each of the groups on the standardized reading test relative to the population upon which the norms for the test were based, the mean scores were converted to grade equivalents. The grade equivalent corresponding to the mean score for the total sample on the Speed and Accuracy section was 6.8. The grade equivalents corresponding to the mean scores for each of the groups on the Speed and Accuracy section ranged from 5.5 for Group I to 8.4 for Group VI. The grade equivalent corresponding to the mean score for the total sample on the Vocabulary section was 7.3 while the grade equivalents corresponding to the mean

scores for each of the groups on the same section ranged from 6.6 for Group III to 8.4 for Group V. Similar values for the Comprehension section were grade 6.8 for the total sample and grades 6.0 for Group III to 7.6 for Group V. It may be noted that for both the Vocabulary and Comprehension sections Group III achieved the lowest mean score.

Since the subjects were approaching the end of their third month in grade six at the time of the administration of the tests, it may be considered that their performance on the Gates-MacGinitie Reading Test was slightly above the mean grade level equivalent for the population upon which the test was standardized. Only in the case of the mean scores for Groups I, II and V on the Speed and Accuracy section and Group III on the Comprehension section did the grade equivalents fall slightly below the grade 6.3 level. Since it has already been shown that the sample appeared to be slightly above the means for the standardized test of mental maturity, it was perhaps not surprising that in general their performance on the standardized test of reading achievement was also slightly above the mean.

While the results of the individual groups have in general appeared to be very similar, some differences between the performance of individual groups, particularly Group III, and the remaining groups on specific tests have been noted. As a result the question may be raised whether or not the individual groups differed significantly on any variable which may be relevant to the question examined in this research project.

V. Analysis of the Variance Between the Groups on Selected Variables

In order to examine the possibility that the groups may have differed significantly from each other in some respect which may affect the interpretation of the findings of this study, an analysis of variance between the groups was undertaken using the Newman-Keuls test of comparison between ordered means (Winer, 1962, p. 102). The variables upon which the groups were compared were those of age, the scores derived from the standardized tests of mental maturity and reading achievement and the results of the three cloze tests.

The instances in which significant differences between the groups apppeared are reported in Table IX all other tables reporting the analysis are included in Appendix F. It may be seen from Table IX that Group VI differed significantly from Group I ($p < .05$) on the Speed and Accuracy section of the _Gates-MacGinitie Reading Test_ while Group III differed significantly from Groups I and V ($p < .05$) on the Memory sub-test of the _California Test of Mental Maturity_. The possibility of this latter finding had been indicated earlier when the performance of the groups on the standardized test of mental maturity was discussed.

At several points in this section it has been indicated that Group III either scored lower than the other groups on a measure, or differed significantly from other groups on a variable. Consequently, it was decided to undertake an analysis of the variance between Group III and the remaining sample. The variables examined were also those of age, the results of the standardized tests and the results on the cloze tests. The instances in which significant differences appeared are reported in Table X all other tables reporting the analysis are

Table IX

NEWMAN-KEULS COMPARISON BETWEEN ORDERED MEANS ON SELECTED VARIABLES

Variable	Multiplier	Means	Table of Newman-Keuls Comparison Between Ordered Means					
	1.20053		6	4	3	5	2	1
		means	21.360	19.560	19.240	17.280	17.280	16.400
Speed and Accuracy	1	16.400	4.960*	3.160	2.840	0.880	0.880	0.0
	2	17.280	4.080	2.280	1.960	0.000	0.0	
	5	17.280	4.080	2.280	1.960	0.0		
	3	19.240	2.120	0.320	0.0			
	4	19.560	1.800	0.0				
	6	21.360	0.0					
	0.79653		1	5	6	2	4	3
		means	16.720	16.640	16.000	15.800	15.120	13.120
California Memory	3	13.120	3.600*	3.520*	2.880	2.680	2.000	0.0
	4	15.120	1.600	1.520	0.880	0.680	0.0	
	2	15.800	0.920	0.840	0.200	0.0		
	6	16.000	0.720	0.640	0.0			
	5	16.640	0.080	0.0				
	1	16.720	0.0					

** $p < .01$
* $p < .05$

contained in Appendix F.

It may be seen from Table X that Group III differed significantly from the remainder of the sample on the Memory sub-test ($p < .01$) and the Language sub-section ($p < .05$) of the California Test of Mental Maturity and on the results of the cloze test based upon Article III ($p < .05$). In all other instances the differences did not reach the level of significance although the difference on the Comprehension section of the Gates-MacGinitie Reading Test approached the level of significance. While the significant differences between Group III and the remainder

Table X

ANALYSIS OF VARIANCE : GROUP III COMPARED WITH THE REMAINDER OF THE SAMPLE

Source	SS	MS	df	F	p	Sign.
A. California : Memory						
Groups	0.1796	179.59	1	11.42	0.00094	**
Error	0.2327	15.72	148			
B. California : Language						
Groups	0.4913	491.25	1	5.69	0.01834	*
Error	0.1278	86.35	148			
C. Cloze Test III						
Groups	0.2784	2784.06	1	5.30	0.02267	*
Error	0.7768	524.87	148			
D. Gates-MacGinitie : Comprehension						
Groups	0.2341	234.06	1	3.56	0.06104	NS
Error	0.9723	65.70	148			

** $p < .01$
* $p < .05$
NS not significant

of the sample appeared in only a few of the variables, it is shown in a later section that both the Memory sub-test and Language sub-section of the standardized test of mental maturity and the Comprehension section of the standardized reading test were in general highly correlated with the experimental measures of memory and reading comprehension utilized in this study. Thus Group III appeared to differ from the remainder of the sample in a manner which was pertinent to the question examined in this research project.

With the exception of Group III noted above and the significant difference between Group VI and Group I on the Speed and Accuracy

section of the standardized reading test, the groups did not differ significantly one from another in terms of the variables examined. However, the differences indicated are considered in discussing the findings of the study.

VI. Summary

This general description of the characteristics of the sample appeared to indicate the following findings. The subjects appeared to fall within a relatively narrow age range with a mean for the total sample of approximately eleven years and seven months. More male than female subjects were included in the sample. In terms of the variables of mental maturity and reading achievement, as they were measured in this study, the sample in general scored slightly above the mean for the populations upon which the norms for these tests were based. Where possible differences between the groups were noted, these most often referred to Group III.

An examination of the significance of those differences indicated that Group III differed significantly from the other groups and from the remainder of the sample on factors which may have been pertinent to the results of this study. This finding is considered when the analysis of the relationship between performance on a free recall task and reading comprehension is reported in a later section.

CHAPTER VI

STUDENTS' PERFORMANCE ON THE CLOZE TESTS OF READING COMPREHENSION AND THE FREE RECALL MEMORY TASKS

Prior to an examination of the relationship between performance on a free recall memory task and reading comprehension as measured by the cloze procedure, an overview of the findings concerning the experimental tasks is reported. This chapter describes the performance of subjects on the cloze tests of reading comprehension and the free recall memory tasks. The following chapter examines the relationship between the abilities measured by these two types of tasks.

I. Performance on the Cloze Tests of Reading Comprehension

An indication of the difficulty of the three cloze tests based upon the three articles used in the study is provided in Table XI. This table reports the number of blanks for each article and the mean number of correct insertions by the total sample for each of the three articles and for the combined results for all three articles. A percentage of correct responses was calculated using the total number of blanks and the mean number of correct insertions. This percentage of correct responses was used to yield an estimate of a comparable percentage score for a multiple-choice test according to the conversion table constructed by Bormuth (1967).

It may be seen from Table XI that the subjects found the cloze test based upon Article I to be the most difficult completing only 34.77% of the blanks correctly and the cloze test based upon Article II

Table XI

SUMMARY OF PERCENTAGE CORRECT ON CLOZE TESTS FOR TOTAL SAMPLE

	No. of Blanks	Mean No. Correct	%age	Converted Score
Art. I	151	52.50	34.77	60%
Art. II	121	64.78	53.47	93%
Art. III	166	74.47	44.82	80%
Combined Cloze	438	191.77	43.77	73%

to be the least difficult in that they correctly completed 53.47% of the blanks. A total of 44.82% of the blanks for the cloze test based upon Article III were correctly completed while in total 43.77% of all blanks provided in the three cloze tests were correctly completed by the total sample. A Z test of the variance of proportions performed upon the percentages correct for the three articles indicated that the difference between the cloze test based upon Article I and the cloze test based upon Article II was significant ($p < .01$) with a Z value of 2.663. Other differences were not significant.

As indicated by the percentage of blanks correctly completed and the converted multiple-choice scores, it would appear that all three cloze tests were reasonably difficult for the subjects. Furthermore, the range of difficulty probably provided an indication of the ability of subjects to comprehend both easy and difficult material within a reasonable range. The variable of article difficulty is examined in reference to the relationship between memory and reading comprehension in Chapter VII.

The mean scores and standard deviations for each of the groups for each of the cloze tests is reported in Table XII. It would appear from this table that in general the groups did not vary greatly in their results for any of the cloze tests. This conclusion was supported by the analysis of variance reported previously in Chapter V. However, it could also be seen from Table X that Group III scored significantly lower than the remainder of the sample on the cloze test based upon Article III.

Table XII

SUMMARY OF CLOZE TEST SCORES

Group		Article I	Article II	Article III	Combined Cloze
I	Mn.	55.08	67.96	74.96	198.00
	S.D.	17.04	14.93	26.81	54.06
II	Mn.	56.56	65.92	75.09	197.56
	S.D.	17.53	15.59	22.61	52.55
III	Mn.	49.24	63.44	64.84	177.52
	S.D.	17.35	22.98	15.58	49.00
IV	Mn.	51.28	59.60	73.44	184.32
	S.D.	19.78	22.63	27.07	68.24
V	Mn.	51.40	67.64	81.56	200.60
	S.D.	13.57	12.07	17.15	39.20
VI	Mn.	51.56	64.12	76.96	192.64
	S.D.	18.10	18.25	23.83	56.49

In order to examine the possibility that each of the three cloze tests may have been measuring different abilities, inter-correlations were calculated among the results for the three tests and appear in Table XIII. It may be seen that all three tests were significantly correlated one with another ($p < .01$). The correlation between the results of the cloze tests for Articles I and II was 0.748, for

Table XIII

INTER-CORRELATION OF CLOZE SCORES FOR THE TOTAL SAMPLE

	Article II	Article III	Combined Cloze
Article I	0.747**	0.820**	0.921**
Article II		0.763**	0.901**
Article III			0.945**

** $p < .01$
* $p < .05$

Articles I and III it was 0.820 and for Articles II and III the correlation coefficient was 0.763. Since the three tests were so highly inter-related, it appeared defensible to combine an individual's scores on all three tests to form a combined cloze score. It may be seen that the correlations between the combined cloze score and the cloze scores based upon the individual articles ranged from 0.901 to 0.945. Thus it appeared that the three articles probably represent similar tasks, although one part of the task appeared to be more difficult than another.

II. Relationship Between Cloze Test Results and Selected Variables

An examination was made of the relationship between the results on the cloze tests of reading comprehension and the variables of age, sex, mental maturity and reading achievement. This section reports the results of that examination.

Age

The relationship between the scores achieved on the cloze tests and the age of the subjects in the total sample was examined using multiple linear regression equations. These results are reported in Table XIV. It may be seen that in all cases the relationship between the cloze test results and age reached the level of significance ($p < .01$). An examination of the correlations indicated that they were

Table XIV

RELATIONSHIP BETWEEN CLOZE RESULTS AND AGE
FOR COMBINED SAMPLE

Cloze Test	df.num.	df.denom.	F-ratio	p	Sign.
Cloze I	1	148	23.7219	0.00001	**
Cloze II	1	148	31.8006	0.00001	**
Cloze III	1	148	30.6939	0.00001	**
Combined Cloze	1	148	34.9112	0.00001	**

** $p < .01$
* $p < .05$

negative. Thus older students tended to do more poorly than younger students on the cloze tests, in spite of the rather narrow age range. This finding may have resulted from the fact that older students may have been retained in an earlier grade or grades and may have had more difficulty with school work in general.

Sex

The relationship between the results of the cloze tests and the sex of the subjects in the total sample was examined using multiple linear regression equations. The results are reported in Table XV. It may be seen that the relationship between the results on the cloze test based upon Article II and the sex of the subjects reached the level of significance ($p < .05$). An examination of the correlations indicated

Table XV

RELATIONSHIP BETWEEN CLOZE RESULTS AND SEX
FOR COMBINED SAMPLE

Cloze Test	df.num.	df.denom.	F-ratio	p	Sign.
Cloze I	1	148	1.1811	0.27885	NS
Cloze II	1	148	4.8992	0.02839	*
Cloze III	1	148	0.4146	0.52057	NS
Combined Cloze	1	148	1.8574	0.17493	NS

** $p < .01$
* $p < .05$

that female subjects scored higher than male subjects on the cloze test for Article II. In all other cases the relationship was not significant.

Mental Maturity

The relationship between the results of the cloze tests and those on the California Test of Mental Maturity was examined by means of multiple linear regression equations. The results are reported in Table XVI. It may be seen that a significant relationship existed between the cloze test results for each of the articles as well as the combined cloze test results and the results of the Non-language and Language sub-sections as well as the Total score ($p < .01$). While all of the relationships reached the level of significance, it may be noted that the F-ratios for the Language sub-section were much higher than those for the Non-language sub-section while those for the Total

Table XVI

RELATIONSHIP BETWEEN CLOZE TEST RESULTS AND MEASURES OF MENTAL MATURITY FOR COMBINED SAMPLE

Measure	Cloze Test	df.num.	df.denom.	F-ratio	p	Sign.
Non-lang.	I	1	148	16.4823	0.00008	**
Non-lang.	II	1	148	16.0687	0.00010	**
Non-lang.	III	1	148	17.9760	0.00004	**
Non-lang.	Comb.	1	148	20.2202	0.00001	**
Lang.	I	1	148	78.6068	0.00001	**
Lang.	II	1	148	98.8356	0.00001	**
Lang.	III	1	148	135.6101	0.00001	**
Lang.	Comb.	1	148	135.6101	0.00001	**
Total	I	1	148	73.2767	0.00001	**
Total	II	1	148	82.2514	0.00001	**
Total	III	1	148	100.6535	0.00001	**
Total	Comb.	1	148	113.2460	0.00001	**

** $p < .01$
* $p < .05$

score fell in between. It was reported previously in Table X that Group III scored significantly lower than the remainder of the sample on the Language sub-section. Such a difference may mean that Group III differed from the rest of the sample in terms of some ability or abilities which were relevant to this study.

Reading Achievement

The relationship between the results of the cloze tests and those on the Gates-MacGinitie Reading Test was examined and the results are reported in Table XVII. This table indicates that the correlation coefficients between the cloze scores for each of the articles as well as the combined cloze score and the results of each of the sections of the standardized reading test reached the level of significance ($p < .01$). The correlation coefficients for the Speed and Accuracy section tended to be the lowest ranging from 0.523 to 0.617. Those for the Comprehension section tended to be the highest ranging from 0.732 to 0.826. Those for the Vocabulary section ranged from 0.601 to 0.684. Again it may be seen that since the difference between the results for Group III and those for the remainder of the sample on the Comprehension section approached the level of significance as reported in Table X, Group III may have been weaker in an ability or abilities which may be relevant to this research project.

Summary

This overview of the subjects' performance on the cloze tests of reading comprehension appeared to indicate the following findings:

1. Subjects found the cloze tests to be reasonably difficult with

Table XVII

CORRELATION COEFFICIENTS BETWEEN CLOZE TEST SCORES AND STANDARDIZED READING TEST SCORES FOR TOTAL SAMPLE

	Speed and Accuracy	Vocabulary	Comprehension
Cloze I	0.602 **	0.601 **	0.754 **
Cloze II	0.523 **	0.612 **	0.732 **
Cloze III	0.583 **	0.670 **	0.795 **
Combined Cloze	0.617 **	0.684 **	0.826 **

** $p < .01$
* $p < .05$

a range of difficulty among the three separate tests.

2. The performance of the individual groups did not vary significantly one from another on the cloze tests with the exception of Group III which scored significantly lower than the remainder of the sample on the cloze test based upon Article III.

3. Performance on one cloze test was highly correlated with performance on the others, thus indicating a commonality among the tests.

4. Subjects' performance on the cloze tests was significantly related to age but only in the case of the cloze test for Article II was performance related to the sex of the subjects. Furthermore, performance on the cloze tests was significantly related to performance on the standardized tests of mental maturity and reading achievement. This latter finding confirmed the results reported previously by Jenkinson (1957), Fletcher (1959) and those reported by Rankin (1965) and Hafner

(1965) that the results of cloze tests are significantly related to the results of standardized tests of reading achievement and mental ability.

III. Performance on the Free Recall Memory Tasks

The free recall protocols for the three types of recall tasks were scored first for the number of words correctly recalled, the N measure. The SOL and LOL tasks were analyzed for evidence of organization in free recall as indicated by the R and RR scores. In addition, each of the recall protocols for the SOL and LOL tasks was analyzed for the number of clusters of from two to five words. The tabulated results of this analysis was referred to as "cluster scores". The protocols for all three types of recall tasks were scored for incorrect responses. The total number of errors (Etot.) was obtained for each protocol as was the number of errors of repetition (Er.). An error of repetition was a correct item included more than once in a recall protocol. For the SOL task the total number of errors was further analyzed into categorical errors (Ec.) and irrelevant errors (Ei) following the precedent set by Bousfield (1953). Categorical errors were incorrect responses which could be classified among the categories present in the stimulus list while irrelevant errors could not be so classified. The subjects' performance on the free recall tasks is discussed in terms of these measures following which an analysis is reported of the relationship between results on the free recall tasks and the variables of age, sex, mental maturity and reading achievement.

Clustering in Free Recall

A summary of the results for the total sample and the groups on the free recall tasks is reported in Table XVIII. It must be remembered that the results were not necessarily comparable between groups, since, according to the group testing format, the groups received the free recall tasks based upon different articles. Those groups which did receive the same type of free recall task based upon the same article, that is, Groups I and IV, II and V, and III and VI, received them in alternating order with the cloze tests. However, with this caution in mind, certain observations and comparisons could be made.

Table XVIII

SUMMARY OF FREE RECALL RESULTS

		Semantic			Linguistic			Random
Group		N score	R score	RR score	N score	R score	RR score	N score
I	Mn.	11.16	3.44	0.33	8.36	1.84	0.25	9.04
	S.D.	3.43	2.25	0.16	2.00	1.16	0.15	2.47
II	Mn.	11.12	3.52	0.33	7.72	0.92	0.14	8.36
	S.D.	3.23	2.44	0.18	2.44	0.89	0.15	2.02
III	Mn.	8.60	2.08	0.27	7.20	1.36	0.20	9.60
	S.D.	2.10	1.55	0.17	2.30	1.20	0.16	1.92
IV	Mn.	10.60	2.52	0.26	8.32	1.28	0.17	8.84
	S.D.	3.10	1.55	0.17	2.48	1.04	0.12	2.59
V	Mn.	10.44	2.68	0.27	8.04	0.96	0.13	8.52
	S.D.	2.06	1.57	0.13	2.49	1.04	0.12	2.33
VI	Mn.	13.12	3.28	0.27	8.04	0.56	0.08	9.44
	S.D.	2.52	1.48	0.10	2.57	0.70	0.09	2.39
Comb.	Mn.	10.84	2.92	0.29	7.95	1.15	0.16	8.97
	S.D.	3.09	1.92	0.16	2.42	1.09	0.15	2.34

The R and RR scores, as indicated in Table XVIII for the SOL tasks, revealed that subjects in the age range from approximately eleven to thirteen years exhibited clustering in their free recall of word lists containing a semantic basis for organization in memory processes, as that basis has been defined in this study. In particular, the mean RR scores for the total sample and the individual groups appeared to be only slightly lower than those quoted by Cofer (1965) in a review of the findings concerning clustering in the first free recall of categorized word lists by university students. The mean RR scores in this study for the SOL tasks ranged from 0.26 for Group IV to 0.33 for Groups I and II with a mean for the total sample of 0.29.

A summary of the results for the total sample and the groups on the LOL free recall tasks is also reported in Table XVIII. The R and RR values for the LOL tasks appeared to be considerably lower than those reported for the SOL tasks. No group received a higher mean R or RR score on the LOL task than on the SOL task. While it was true that no single group performanced the two tasks with lists based upon the same article, the consistency of the finding was impressive, particularly when it was considered that, with the exception of Group III, the groups were not considered to be significantly different in terms of the variables examined. Furthermore, the mean RR values for the LOL tasks did not approach those quoted in a review of the research on clustering by Cofer (1965) for the free recall of word lists organized according to part-of-speech.

Thus, on the basis of the above evidence, it appeared that subjects in the age range from approximately eleven to thirteen years did not exhibit clustering on the basis of part-of-speech in their free recall

of word lists. Since it has already been indicated that subjects did exhibit clustering in their free recall on the SOL tasks, it would appear that there may be differences between the semantic and linguistic tasks as they have been defined in this study.

<u>Differences in Performance on the Three Types of Recall Tasks</u>

Table XVIII also shows the mean number of words recalled correctly by the total sample and by each group for the three types of free recall tasks. An examination of the mean N scores for the total sample and for each of the groups for the three different types of free recall tasks indicated that, with one exception, the mean N score for the SOL task was the highest, the mean N score for the LOL task was the lowest, while the mean N score for the ROL task fell between these two values. For example, the mean N score for the SOL task for the Group I was 11.16, for the LOL task the mean N score was 8.36 and for the ROL task the mean N score was 9.04. The mean N scores for the three types of free recall tasks exhibited a similar trend for the total sample and for Groups II, IV, V and VI. Thus there was considerable consistency in the finding that subjects recalled the greatest number of words from the SOL lists, the fewest number from the LOL lists and that the values for the ROL lists fell in between. The one exception was Group III where the mean N score for the ROL task was higher than the mean N score for either the SOL or LOL tasks. It has already been indicated that Group III differed from the remainder of the sample on variables which could affect their performance on the experimental tasks.

In order to examine the possibility of significant differences between the N measures for the three different types of recall tasks, an

analysis of variance was undertaken. The results of this analysis are presented in Table XIX. This table indicates that while the differences between groups on the N measures did not reach the level of significance the differences between the N measures for the three different types of free recall tasks within the groups was significant ($p < .01$). This confirmed the suspicion stated earlier that subjects performed differently on the three types of recall tasks.

Table XIX

ANALYSIS OF THE VARIANCE OF THE N MEASURES FOR THE THREE TYPES OF FREE RECALL TASKS

Source of Variation	df.	MS	F	p	Sign.
Between Subjects	149				
A (Groups)	5	25.275	2.144	0.06361	NS
Subjects Within Groups	144	11.789			
Within Subjects	300				
B (SOL, LOL, ROL)	2	323.010	83.217	0.00001	**
B X Subjects Within Groups	288	3.882			

** $p < .01$
* $p < .05$

Thus it appeared that subjects' performance on the three different types of recall tasks differed according to the task. Subjects exhibited a greater degree of clustering in their recall of SOL lists than in their recall of LOL lists. Subjects, with the exception of Group III, recalled most words from the SOL lists, fewest from the LOL lists with the number of words for the ROL list correctly recalled falling somewhere between these two values.

Since it has already been shown that, with the exception of Group III, the groups did not appear to be significantly different one from another, it would seem unlikely that the differences in the results for the three types of recall tasks could be attributed to differences in the groups. Since the group testing format insured that each type of recall task occurred in each of the three positions, initial, medial and final, it would appear unlikely that the differences could be attributed to an order effect. Furthermore, since each type of free recall task was based on each of the three different articles, it would appear unlikely that the differences in the performance of the subjects on the three types of recall tasks could be attributed to the articles upon which they were based. Consequently, it seemed probable that the differences in the performance of the subjects was attributable to some factor intrinsic to the three types of recall tasks. The recall tasks based upon the SOL, LOL and ROL lists were different and this difference must be kept in mind when examining the relationship between performance on a free recall task and reading comprehension.

Thus, from the theoretical background it was decided that two categories of organization in free recall were possible, the semantic and the linguistic, which appeared to comply with the potentialities present in connected discourse for organization in memory processes. In addition, a further category, the random, was constructed as a comparison to the first two. Experimental validation has been given to the theoretical differences which were used as a basis for the construction of the three different types of recall lists.

Cluster Scores

A summary of the means and standard deviations for the total sample and for the groups of the cluster scores within the SOL and LOL free recall tasks is reported in Table XX. Each cluster of from two to five words from the same category was tabulated for each protocol. The mean number of two word clusters for the total sample in response to the SOL task was 1.73 while the mean number of two word clusters for individual groups ranged from 2.60 for Group VI to 1.28 for Group III. The mean number of three word clusters for the total sample in response to the SOL task was 0.49 while the mean number of three word clusters for individual groups ranged from 0.52 for Group I to 0.28 for Group VI.

Table XX

SUMMARY OF CLUSTER SCORES

Group		SOL 2	SOL 3	SOL 4	SOL 5	LOL 2	LOL 3	LOL 4	LOL 5
I	Mn.	1.76	0.52	0.16	0.04	1.52	0.16	0.0	0.0
	S.D.	1.42	0.70	0.40	0.20	0.99	0.37	0.0	0.0
II	Mn.	1.72	0.84	0.04	0.0	0.84	0.04	0.0	0.0
	S.D.	1.31	1.01	0.20	0.0	0.78	0.20	0.0	0.0
III	Mn.	1.28	0.32	0.0	0.04	0.92	0.16	0.04	0.0
	S.D.	0.87	0.55	0.0	0.20	0.93	0.37	0.20	0.0
IV	Mn.	1.52	0.44	0.04	0.0	1.04	0.12	0.0	0.0
	S.D.	1.14	0.57	0.20	0.0	1.00	0.33	0.0	0.0
V	Mn.	1.52	0.52	0.04	0.0	0.80	0.08	0.0	0.0
	S.D.	1.03	0.70	0.20	0.0	0.94	0.27	0.0	0.0
VI	Mn.	2.60	0.28	0.04	0.0	0.56	0.0	0.0	0.0
	S.D.	1.10	0.45	0.20	0.0	0.70	0.0	0.0	0.0
Comb.	Mn.	1.73	0.49	0.05	0.01	0.95	0.09	0.01	0.0
	S.D.	1.23	0.71	0.22	0.11	0.94	0.29	0.08	0.0

Clusters of four or five words were relatively infrequent for the SOL tasks and particularly for the LOL tasks. The mean number of two word clusters for the total sample in response to the LOL task was 0.95 while while the mean number for individual groups ranged from 1.52 for Group I to 0.56 for Group VI. The mean number of three word clusters for the total sample in response to the LOL tasks was 0.09 with means for individual groups ranging from 0.16 for Groups I and III to 0.0 for Group VI.

These results appeared to indicate that two and three word clusters were more frequent than clusters of four or five words. Furthermore, there appeared to be a greater tendency for clustering to occur in response to the SOL tasks than in response to the LOL tasks, again indicating differences in the performance of subjects on the two different tasks and again indicating the superiority of the semantic basis for organization over the linguistic, as these have been defined in this study.

Error Scores

In order to gain some indication of the incorrect responses that students made, the errors were classified and tallied. A summary of error scores appears in Table XXI. It will be remembered that Etot. refers to the total number of errors while Er. refers to the number of repetition errors. Ei. stands for irrelevent errors while Ec. stands for categorical errors. A list of all errors considered to be categorical in nature is contained in Appendix E.

The mean number of errors for the total sample in response to the SOL tasks was 0.81 while similar values for the LOL and ROL tasks were

Table XXI

SUMMARY OF ERROR SCORES

Group		SOL				LOL		ROL	
		Er.	Ei.	Ec.	Etot.	Er.	Etot.	Er.	Etot.
I	Mn.	0.04	0.32	0.04	0.40	0.12	1.00	0.08	0.72
	S.D.	0.20	0.88	0.20	0.89	0.33	1.13	0.27	1.00
II	Mn.	0.0	0.56	0.72	1.28	0.04	1.84	0.24	3.40
	S.D.	0.0	1.20	0.87	1.51	0.20	1.80	0.43	3.61
III	Mn.	0.12	0.32	0.12	0.56	0.04	0.96	0.12	1.12
	S.D.	0.33	0.62	0.33	0.90	0.20	1.31	0.43	1.18
VI	Mn.	0.0	0.56	0.32	0.88	0.16	1.36	0.12	2.12
	S.D.	0.0	1.02	0.73	1.37	0.46	2.06	0.33	3.24
V	Mn.	0.0	0.32	0.44	0.76	0.08	1.08	0.12	1.48
	S.D.	0.0	0.62	0.64	0.86	0.27	1.16	0.33	1.50
VI	Mn.	0.12	0.72	0.20	0.96	0.12	2.04	0.24	1.68
	S.D.	0.33	1.73	0.40	2.03	0.59	2.41	0.51	1.67
Total	Mn.	0.05	0.47	0.31	0.81	0.09	1.38	0.15	1.75
	S.D.	0.21	1.09	0.62	1.36	0.37	1.77	0.40	2.43

Er = repetition error
Ei = irrelevant error
Ec = categorical error
Etot = total number of errors

1.38 and 1.75. The mean number of errors for individual groups in response to the SOL tasks ranged from 1.28 for Group II to 0.40 for Group I while similar values for the LOL tasks were 2.04 for Group VI and 0.96 for Group III while for the ROL tasks they were 3.40 for Group II and 0.72 for Group I. Thus it would appear that the total number of

errors was low for all three types of free recall tasks and particularly low in the case of the SOL tasks. The subjects did not appear to include many incorrect responses in their recall of the presented words and it would appear that any theory of memory must adequately explain this ability to refrain from giving incorrect responses.

The breakdown of the total number of errors into their subclassifications indicated that repetition errors, while present, did not appear very frequently. Over the total sample, repetition errors accounted for six percent of all errors in response to the SOL tasks and seven percent of all errors in response to LOL and ROL tasks. Categorical errors constituted 38% of the errors in response to the SOL tasks for the total sample while irrelevant errors accounted for 58%. Thus irrelevant errors appeared to be the most common type of error in response to the SOL tasks.

IV. Relationship Between Free Recall Results and Selected Variables

An examination was made of the relationship between the results of the free recall memory tasks and the variables of age, sex, mental maturity and reading achievement. This section reports the results of that examination.

Age

The relationship between the scores achieved on the measures of free recall and the age of the subjects in the total sample was examined using multiple linear regression equations. The results are reported in Table XXII. It may be seen from this table that there was a significant relationship between the N measure for the SOL tasks and age

Table XXII

RELATIONSHIP BETWEEN FREE RECALL RESULTS AND AGE
FOR COMBINED SAMPLE

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	148	6.1891	0.01396	*
Semantic	R	1	148	2.5528	0.11220	NS
Semantic	RR	1	148	0.1537	0.69546	NS
Linguistic	N	1	148	2.9134	0.08992	NS
Linguistic	R	1	148	1.6848	0.19630	NS
Linguistic	RR	1	148	0.5851	0.44551	NS
Random	N	1	148	8.4815	0.00414	**

** $p < .01$
* $p < .05$

($p < .05$) and between the N measure for the ROL tasks and age ($p < .01$). In all other cases the relationships did not reach the level of significance for the total sample.

Sex

The relationship between the measures of free recall and the sex of the subjects in the total sample was similarly examined by means of multiple linear regression equations and is reported in Table XXIII. A significant relationship existed between the N measure for the LOL tasks and the sex of the subjects ($p < .01$). In all other cases the relationship did not reach the level of significance.

Table XXIII

RELATIONSHIP BETWEEN FREE RECALL RESULTS AND SEX
FOR COMBINED SAMPLE

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	148	0.3833	0.53662	NS
Semantic	R	1	148	0.1373	0.71139	NS
Semantic	RR	1	148	0.1005	0.75164	NS
Linguistic	N	1	148	11.0651	0.00111	**
Linguistic	R	1	148	1.0134	0.31566	NS
Linguistic	RR	1	148	0.0007	0.97951	NS
Random	N	1	148	2.9051	0.09040	NS

** $p < .01$
* $p < .05$

Mental Maturity

The relationship between the results on the free recall tasks and those on the standardized test of mental maturity was examined and the correlation coefficients are reported in Table XXIV for the total sample. The coefficients are presented between the free recall measures and the results of the Non-language, Language, and Total tests of the California Test of Mental Maturity. It may be seen that for the total sample a correlation coefficient of 0.422 existed between the N measure for the SOL tasks and the results of the Language sub-section and that a correlation coefficient of 0.306 existed between the N measure for the SOL tasks and the Total score. Both of these were significant ($p < .01$). The correlation coefficient of 0.092 between the N measure for the SOL tasks and the results on the Non-language sub-section did not reach the

Table XXIV

CORRELATION COEFFICIENTS BETWEEN FREE RECALL SCORES AND RESULTS OF STANDARDIZED TEST OF MENTAL MATURITY FOR TOTAL SAMPLE

	SOL			LOL			ROL
	N	R	RR	N	R	RR	N
Non-Lang.	0.092	0.050	-0.018	0.147	0.061	-0.003	0.063
Lang.	0.422**	0.258**	0.013	0.218**	0.074	-0.023	0.215**
Total	0.306**	0.132	-0.094	0.222**	0.097	-0.002	0.171**

** $p < .01$
* $p < .05$

level of significance.

The correlation coefficient of 0.258 between the R measure for the SOL tasks for the total group and the results of the Language sub-section reached the level of significance ($p < .01$). However, the correlations between the R measure for the SOL lists for the total sample and the results on the Non-language sub-section and the Total scores, which were 0.050 and 0.132 respectively, did not reach the level of significance. A non-significant correlation coefficient of -0.018 existed between the RR measure for the SOL tasks and the results on the Non-language sub-section for the total sample. In addition, non-significant correlation coefficients of 0.013 and -0.094 existed between the RR measure for the SOL tasks and the results for the Non-language sub-section and the Total score, respectively.

The correlations between the measures of free recall for the LOL

tasks and the results on the standardized test of mental maturity are also reported in Table XXIV. It may be seen that for the total sample significant correlations of 0.218 and 0.222 existed between the N measure for the LOL tasks and the results of the Language sub-section and Total scores respectively ($p < .01$). All other correlation coefficients did not reach the level of significance.

Table XXIV also reports the correlation coefficients between the N measure for the ROL tasks and the results of the standardized test of mental maturity. A non-significant correlation of 0.063 existed between the N measure for the ROL tasks and the results of the Non-language sub-section for the total sample. A significant correlation ($p < .01$) of 0.215 existed between the N measure for the ROL tasks and the results of the Language sub-section for the total sample. A significant correlation ($p < .05$) of 0.172 existed between the N measure for the ROL tasks and the results on the Total test for the entire sample.

Reading Achievement

Correlation coefficients were calculated to indicate the relationship between the measures of free recall and the results of the Gates-MacGinitie Reading Test for the total sample. These are reported in Table XXV. This table indicates that significant correlations existed between the N measure for the SOL tasks and all three sections of the standardized reading test for the total sample ($p < .01$). The correlation coefficient between the N measure for the SOL tasks and the results on the Speed and Accuracy section was 0.308, while with the Vocabulary section it was 0.296 and with the Comprehension section it was 0.363, the highest correlation coefficient of the three. The R measure for

Table XXV

CORRELATION COEFFICIENTS BETWEEN FREE RECALL SCORES AND RESULTS OF TEST OF READING ACHIEVEMENT FOR TOTAL SAMPLE

	SOL N	SOL R	SOL RR	LOL N	LOL R	LOL RR	ROL N
Speed	0.308**	0.150	-0.030	0.211**	0.035	-0.051	0.313**
Vocab.	0.296**	0.080	-0.113	0.112	-0.026	-0.114	0.161*
Comp.	0.363**	0.162	-0.061	0.173*	-0.026	-0.135	0.213**

** $p < .01$
* $p < .05$

the SOL tasks for the total sample was significantly correlated ($p < .05$) with the Comprehension section, where a coefficient of 0.162 existed, but did not significantly correlate with the results of the other two sections. None of the correlation coefficients between the RR measure for the SOL tasks for the total sample and the three sections of the standardized test of reading achievement reached the level of significance.

Table XXV also reports the correlation coefficients between the measures of performance for the LOL free recall tasks and the results of the standardized test of reading achievement for the total sample. It may be seen that a significant correlation of 0.211 existed between the N measure for the LOL tasks and the results of the Speed and Accuracy section ($p < .01$). Similarly, a significant correlation of 0.173 existed between the N measure for the LOL tasks and the results of the Comprehension section ($p < .05$). However, the correlation coefficient

of 0.112 between the N measure for the LOL tasks and the results for the Vocabulary section was not significant. None of the correlations between either the R measure or the RR measure for the LOL tasks and the the results of the three sections of the standardized reading test for the total sample reached the level of significance.

Also reported in Table XXV are the correlation coefficients between the N measure for the ROL tasks and the results of the standardized test of reading achievement for the total sample. Significant correlation coefficients of 0.313 and 0.213 existed between the N measure for the ROL tasks and the results on the Speed and Accuracy section and Comprehension section of the standardized test of reading achievement ($p < .01$). In addition, the correlation coefficient of 0.161 between the N measure for the ROL tasks and the results for the Vocabulary section for the total sample was also significant ($p < .05$).

Summary

The preceding analysis of the subjects' performance on the free recall tasks seemed to indicate the following findings. While subjects appeared to exhibit organization in the free recall of words selected on a semantic basis, as indicated by an analysis of clustering in their free recall protocols, there was little evidence to indicate organization in the free recall of words selected on a linguistic basis as these bases have been defined in this study. In addition to the above difference in the performance of subjects on the SOL and LOL tasks, students consistently recalled the greatest number of words on the SOL task, the fewest number on the LOL task while the number for the ROL task fell somewhere between these two values. These differences tended to support

the conclusion that the three types of free recall tasks did in fact pose differing problems for subjects.

In addition, it was found that two and three word clusters were far more frequent than four or five word clusters. Errors were relatively few in number, particularly in the recall of the SOL tasks.

An examination of the relationship between the measure of free recall and the variables of age, sex, mental maturity and reading achievement seemed to indicate the following findings. The N measure for the SOL tasks and the N measure for the ROL tasks for the total sample were significantly related to age. However, none of the other measures of free recall was significantly related to age. The N measure for the LOL tasks for the total sample was significantly related to the sex of the subjects, with girls scoring higher than boys. None of the other measures of free recall were significantly related to the variable of sex.

The N measure for the SOL tasks for the total sample was significantly correlated with the results of the Language sub-section and Total test scores for the standardized test of mental maturity but not significantly related to the results for the Non-language sub-section. Of the remaining measures of SOL free recall, only the R measures for the total sample was significantly related to the results of the Language sub-section of the test of mental maturity. None of the other correlation coefficients reached the level of significance. Only the N measure for the LOL free recall tasks was significantly correlated with the Language and Total results for the test of mental maturity for the total sample. The N measure for the ROL tasks was significantly related to the results of the Language sub-section and the Total test

scores for the total sample. The correlation between the N measure for the ROL tasks and the results of the Non-language sub-section did not reach the level of significance.

The N measure for the SOL tasks was significantly correlated with the results of all three sections of the standardized test of reading achievement for the total sample. However, with the exception of the R measure and the Comprehension section, none of the remaining measures of SOL free recall tasks correlated significantly with the results of the standardized tests of reading achievement for the total sample. The N measure for the LOL tasks correlated significantly with the Speed and Accuracy section results for the total sample. None of the other correlations between the measures of free recall for the LOL tasks and the results of the standardized test of reading achievement reached the level of significance. The N measure for the ROL tasks of free recall was significantly correlated with the results of all three sections for the total group on the standardized test of reading achievement.

V. Summary

This chapter has described the performance of the subjects on the experimental measures of memory and reading comprehension prior to an examination of the relationship between the results of the two types of tasks. The findings appeared to be as follows.

The cloze tests based upon the three different articles offered a range of difficulty. Performance on one cloze test was highly related to performance on the other two. With the exception of the results for Group III on the cloze test for Article III, the groups did not differ significantly in their results for the cloze tests. Cloze test performance was related in varying degrees to the variables of age, sex, mental

maturity and reading achievement.

Subjects appeared to exhibit organization in the free recall of SOL but not of LOL word lists. Subjects recalled the greatest number of words from the SOL lists, the fewest number from the LOL lists with the value for the ROL lists falling somewhere in between. Thus subjects performed differently on the three types of free recall tasks. Few errors were made and clusters of two and three words were more frequent than clusters of four and five words. The measures of performance on the free recall tasks were related in varying degrees to the variables of age, sex, mental maturity and reading achievement.

CHAPTER VII

RELATIONSHIP BETWEEN PERFORMANCE ON MEMORY TASKS AND READING COMPREHENSION

This chapter examines the central problem of this research project. An attempt is made to make explicit the relationship between memory processes, as measured by the free recall tasks, and reading comprehension, as measured by the cloze procedure. An analysis of the relationship between the performance of the total sample on the free recall tasks and the combined cloze scores is followed by a description of similar analyses with the factors of age, sex, mental maturity and reading achievement considered. The relationship between performance on a free recall task and reading comprehension is then examined to see if there were significant differences in the relationship from one type of recall task to another, from one article to another, from one measure of performance to another and, from one group to another.

In addition, the relationship between performance on a free recall task and reading comprehension is examined with variants of the memory tasks. First the relationship is examined using the alternate method of scoring the semantic free recall task based upon Article II and then using the results of the delayed free recall tasks. This chapter concludes with an examination of the relationship between the results of the standardized memory test, the free recall scores and the cloze test scores and an examination of the inter-relationship among the measures of performance on the free recall tasks.

I. Relationship Between the Free Recall Measures and the Combined Cloze Scores for the Total Sample

The results of an analysis of the relationship between the free recall measures and the combined cloze scores for the total sample using multiple linear regression equations is reported in Table XXVI. Equations were written using the measures derived from the free recall tasks as predictors of the combined cloze scores. Combinations of measures were also utilized as predictors. The two measures designed to indicate organization in free recall, the R and RR measures, were utilized together as predictors of the combined cloze scores. It was felt that combined knowledge of these two scores might have provided a better indication of the subject's organization in free recall than either measure alone. In addition, all three measures, the N, R and RR measures, were utilized together as predictors of the combined cloze scores. It was felt that knowledge of all three measures may have provided a summary of the subject's total performance on the free recall task. Since the N measure was the only one derived from the random free recall tasks, only one equation could be written.

It may be seen from Table XXVI that with one exception, that of the RR measure, all other measures of the SOL free recall tasks were significant predictors of the combined cloze scores of the total sample. With the exception of the R and RR measures alone, all other measures derived from the LOL free recall tasks were significant predictors of the combined cloze scores for the total sample. In addition, the measure of performance on the ROL tasks was also a significant predictor of the combined cloze scores of the total sample.

The N measure for all three types of free recall tasks was a

Table XXVI

RELATIONSHIP BETWEEN FREE RECALL MEASURES AND
COMBINED CLOZE SCORE FOR TOTAL SAMPLE

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	148	37.2862	0.00001	**
Semantic	R	1	148	9.1529	0.00293	**
Semantic	RR	1	148	0.0062	0.93721	NS
Semantic	R+RR	2	147	18.4802	0.00C01	**
Semantic	N+R+RR	3	146	13.7366	0.00001	**
Linguistic	N	1	148	16.1272	0.00009	**
Linguistic	R	1	148	0.2844	0.59464	NS
Linguistic	RR	1	148	1.5672	0.21255	NS
Linguistic	R+RR	2	147	7.5633	0.00075	**
Linguistic	N+R+RR	3	146	6.7721	0.00026	**
Random	N	1	148	11.9996	0.00070	**

** $p < .01$
* $p < .05$

significant predictor of the combined cloze scores ($p < .01$). The R + RR variable and the N + R + RR variable were also significant predictors of the combined cloze scores for the total sample ($p < .01$). The R measure for the SOL tasks, when considered alone, was a significant predictor of the combined cloze scores for the total sample ($P < .01$), however, neither the RR measure for the SOL tasks nor the R or RR measures for the LOL tasks, when taken alone, was a significant predictor of the combined cloze scores for the total sample.

Null hypothesis 2, which stated that there is no significant relationship between performance on a free recall task and reading

comprehension as measured by the cloze procedure, was thus untenable for all three types of free recall tasks with the exception of the instances in which performance on the SOL tasks was measured by the RR measure and when performance on the LOL tasks was measured by either the R or RR measure alone.

II. Relationship Between the Free Recall Measures and the Combined Cloze Scores with Selected Variables Considered

As it has already been indicated in Tables XIV, XV, XXII and XXIII, significant relationships were found to exist between the variables of age and sex and the experimental measures of memory and reading achievement. In addition, it has also been shown in Tables XVI, XVII, XXIV and XXV that significant relationships were found to exist between the variables of mental maturity and reading achievement and the experimental measures of memory and reading comprehension. It was decided, therefore, to investigate the relationship between the free recall measures and the combined cloze test scores for the total sample with the variables of age, sex, mental maturity and reading achievement taken into consideration by means of multiple linear regression equations. This section describes the results of that analysis.

Age and Sex

Since the results of the analysis of the relationship between the free recall measures and the combined cloze scores for the total sample with the variables of age and sex considered were very similar, they are reported together. The results with age considered are reported in Table XXVII while the results with sex considered are reported in Table XXVIII. It may be seen that the results reported in these two

Table XXVII

RELATIONSHIP BETWEEN FREE RECALL MEASURES AND COMBINED CLOZE SCORE FOR TOTAL SAMPLE WITH AGE CONTROLLED

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	147	29.6524	0.00001	**
Semantic	R	1	147	6.5681	0.01138	*
Semantic	RR	1	147	0.0768	0.78182	NS
Semantic	R+RR	2	146	15.1847	0.00001	**
Semantic	N+R+RR	3	145	11.1869	0.00001	**
Linguistic	N	1	147	12.8721	0.00045	**
Linguistic	R	1	147	0.0012	0.97198	NS
Linguistic	RR	1	147	3.1375	0.07855	NS
Linguistic	R+RR	2	146	7.4552	0.00083	**
Linguistic	N+R+RR	3	145	6.3400	0.00045	**
Random	N	1	147	5.9217	0.01615	*

** $p < .01$
* $p < .05$

tables are comparable to the results of the analysis of the relationship between the free recall measures and the combined cloze scores when no consideration was given to the variables of age and sex, as reported previously in Table XXVI. In all three instances the N, R, R + RR and N + R + RR variables for the SOL tasks, the N, R + RR and N + R + RR variables for the LOL tasks and the N variable for the ROL tasks were significant precictors of the combined cloze scores for the total sample. In some cases, however, the consideration of either age or sex raised the probability value slightly and in two instances, that of the N measure for the ROL tasks and the R measure for the SOL

Table XXVIII

RELATIONSHIP BETWEEN FREE RECALL MEASURES AND COMBINED CLOZE SCORE FOR TOTAL SAMPLE WITH SEX CONTROLLED

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	147	36.5590	0.00001	**
Semantic	R	1	147	8.9484	0.00326	**
Semantic	RR	1	147	0.0131	0.90871	NS
Semantic	R+RR	2	146	18.4712	0.00001	**
Semantic	N+R+RR	3	145	13.5941	0.00001	**
Linguistic	N	1	147	14.1554	0.00024	**
Linguistic	R	1	147	0.1797	0.67193	NS
Linguistic	RR	1	147	1.5837	0.21015	NS
Linguistic	R+RR	2	146	6.8612	0.00142	**
Linguistic	N+R+RR	3	145	6.0924	0.00062	**
Random	N	1	147	10.8848	0.00122	**

** $p < .01$
* $p < .05$

tasks, the level of significance fell from the .01 to the .05 level when age was considered. However, in general it would appear that the relationship between the free recall task results and the cloze tests results was unaffected by the variables of age and sex in this study.

Reading Achievement

The results of an analysis of the relationship between the free recall measures and the combined cloze scores for the total sample with the results on the Speed and Accuracy section of the standardized test of reading achievement considered are reported in Table XXIX. It may be seen that the N measure for the SOL tasks and the combined R + RR and

Table XXIX

RELATIONSHIP BETWEEN FREE RECALL MEASURES AND COMBINED CLOZE SCORE FOR TOTAL SAMPLE WITH SPEED AND ACCURACY RESULTS CONTROLLED

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	147	19.9354	0.00002	**
Semantic	R	1	147	5.5582	0.01970	*
Semantic	RR	1	147	0.0356	0.85026	NS
Semantic	R+RR	2	146	18.8388	0.00003	**
Semantic	N+R+RR	3	145	21.5164	0.00001	**
Linguistic	N	1	147	8.8316	0.00346	**
Linguistic	R	1	147	0.1179	0.73145	NS
Linguistic	RR	1	147	1.2080	0.27338	NS
Linguistic	R+RR	2	146	10.0058	0.00190	**
Linguistic	N+R+RR	3	145	12.2746	0.00061	**
Random	N	1	147	1.7425	0.18879	NS

** $p < .01$
* $p < .05$

N + R + RR measures for the SOL tasks were significant predictors of the combined cloze scores for the total sample ($P < .01$). The R measure for the SOL tasks was also a significant predictor of the combined cloze scores for the total sample ($P < .05$) but the RR measure was not. The N measure for the LOL tasks was a significant predictor of the combined cloze scores for the total sample as were the combined R + RR and N + R + RR variables ($p < .01$). However, the R and RR measures for the LOL tasks and the N measure for the ROL tasks were not significant predictors.

In comparing the results described above with those presented in

Table XXVI where the results on the Speed and Accuracy section were not considered, it may be seen that in all cases where a significant relationship existed on the initial comparison, the probability values were slightly higher when the results of the Speed and Accuracy section were considered. The relationship between the R measure for the SOL task and the combined cloze score became significant at a lower level while the relationship between the N measure for the ROL tasks and the combined cloze scores was no longer significant when the Speed and Accuracy results were considered. However, in spite of these modifications, the relationship between the free recall measures and the combined cloze scores for the total sample remained largely unchanged when the results of the Speed and Accuracy section of the standardized test of reading achievement were considered.

The results of the analysis of the relationship between the free recall measures and the combined cloze scores for the total sample with the results on the Vocabulary section of the standardized reading test considered are reported in Table XXX. It may be seen that the N, R, R + RR and N + R + RR variables for the SOL tasks were all significant predictors of the combined cloze scores for the total sample ($p < .01$) as were the N, R + RR and N + R + RR variables for the LOL free recall tasks and the N measure for the ROL tasks. However, the RR measure for the SOL tasks and the R and RR measures for the LOL tasks were not significant predictors of the combined cloze scores for the total sample when the results on the Comprehension section were considered.

A comparison of the above results with those previously presented in Table XXVI where the results on the Vocabulary section were not considered indicated that the results were comparable. The pattern of

Table XXX

RELATIONSHIP BETWEEN FREE RECALL MEASURES AND
COMBINED CLOZE SCORE FOR TOTAL SAMPLE
WITH VOCABULARY RESULTS CONTROLLED

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	147	20.8927	0.00001	**
Semantic	R	1	147	10.3883	0.00156	**
Semantic	RR	1	147	1.4101	0.23686	NS
Semantic	R+RR	2	146	19.9984	0.00002	**
Semantic	N+R+RR	3	145	21.9749	0.00001	**
Linguistic	N	1	147	17.5197	0.00005	**
Linguistic	R	1	147	1.0615	0.30447	NS
Linguistic	RR	1	147	0.1652	0.68485	NS
Linguistic	R+RR	2	146	9.8441	0.00206	**
Linguistic	N+R+RR	3	145	18.5923	0.00003	**
Random	N	1	147	8.0425	0.00521	**

** $p < .01$
* $p < .05$

significant predictors was exactly the same in both cases. Thus it would appear that the relationship between the free recall measures and the combined cloze scores for the total sample was unaffected when the results on the Vocabulary section of the standardized test of reading achievement were considered.

The results of an analysis of the relationship between the free recall measures and the combined cloze scores for the total sample with the results on the Comprehension section of the standardized test of reading achievement considered are reported in Table XXXI. It may be seen that all of the variables which were significant predictors of the combined cloze scores of the total sample when no consideration

Table XXXI

RELATIONSHIP BETWEEN FREE RECALL MEASURES AND
COMBINED CLOZE SCORE FOR TOTAL SAMPLE
WITH COMPREHENSION RESULTS CONTROLLED

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	147	12.8110	0.00047	**
Semantic	R	1	147	5.7165	0.01806	*
Semantic	RR	1	147	0.8949	0.34554	NS
Semantic	R+RR	2	146	10.5190	0.00146	**
Semantic	N+R+RR	3	145	12.8610	0.00046	**
Linguistic	N	1	147	15.3801	0.00013	**
Linguistic	R	1	147	1.9807	0.16138	NS
Linguistic	RR	1	147	0.0430	0.83570	NS
Linguistic	R+RR	2	146	7.4499	0.00711	**
Linguistic	N+R+RR	3	145	15.5059	0.00013	**
Random	N	1	147	4.8145	0.02977	*

** $p < .01$
* $p < .05$

was given to the results of the Comprehension section, as reported in Table XXVI, remained significant predictors when the results of the Comprehension section were considered. However, in general the probability levels were higher when the Comprehension results were considered. In addition, the relationships between the R measure for the SOL tasks and the combined cloze scores and between the N measure for the ROL tasks and the combined cloze scores were significant at a lower level ($p < .05$) when the Comprehension results were considered. In spite of these modifications, it would appear that the relationship between the free recall measures and the combined cloze scores for the total sample remained largely unchanged when the results on the

Comprehension section of the standardized test of reading achievement were considered.

Mental Maturity

The results of an analysis of the relationship between the free recall measures and the combined cloze scores for the total sample with the results of the Non-language sub-section of the standardized test of mental maturity considered are reported in Table XXXII. It may be seen that the pattern of results presented in the above table was comparable to those presented previously in Table XXVI where no consideration was given to the Non-language sub-section results. All variables which

Table XXXII

RELATIONSHIP BETWEEN FREE RECALL MEASURES AND
COMBINED CLOZE SCORE FOR TOTAL SAMPLE
WITH NON-LANGUAGE RESULTS CONTROLLED

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	147	36.5263	0.00001	**
Semantic	R	1	147	8.9220	0.00330	**
Semantic	RR	1	147	0.0001	0.99299	NS
Semantic	R+RR	2	146	34.7580	0.00001	**
Semantic	N+R+RR	3	145	40.0240	0.00001	**
Linguistic	N	1	147	12.7989	0.00047	**
Linguistic	R	1	147	0.0856	0.77008	NS
Linguistic	RR	1	147	1.7351	0.18974	NS
Linguistic	R+RR	2	146	12.5404	0.00053	**
Linguistic	N+R+RR	3	145	16.9790	0.00006	**
Random	N	1	147	11.4870	0.00090	**

** $p < .01$
* $p < .05$

were significant predictors of the combined cloze scores for the total sample remained significant predictors when the results on the Non-language sub-section were considered. Thus it would appear that the relationship between the free recall measures and the combined cloze scores for the total sample was unaffected when the results of the Non-language sub-section of the standardized test of mental maturity were considered.

The results of an analysis of the relationship between the free recall measures and the combined cloze scores for the total sample with the results of the Memory sub-test considered are reported in Table XXXIII. It may be seen that the pattern of results was comparable to those presented in Table XXVI where no consideration was given to the

Table XXXIII

RELATIONSHIP BETWEEN FREE RECALL MEASURES AND COMBINED CLOZE SCORE FOR TOTAL SAMPLE WITH STANDARDIZED MEMORY RESULTS CONTROLLED

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	147	19.1165	0.00002	**
Semantic	R	1	147	5.7336	0.01790	*
Semantic	RR	1	147	0.0356	0.85033	NS
Semantic	R+RR	2	146	19.6362	0.00002	**
Semantic	N+R+RR	3	145	21.4261	0.00001	**
Linguistic	N 1	1	147	14.4851	0.00021	**
Linguistic	R	1	147	0.1174	0.73205	NS
Linguistic	RR	1	147	1.7671	0.18574	NS
Linguistic	R+RR	2	146	13.5275	0.00033	**
Linguistic	N+R+RR	3	145	18.8311	0.00003	**
Random	N	1	147	7.4613	0.00707	**

** $p < .01$
* $p < .05$

results of the Memory sub-test. All significant predictors of the combined cloze scores for the total sample remained significant predictors when the results of the Memory sub-test were considered. That is, the N measure for the three types of recall tasks and the R + RR and N + R + RR variables for the SOL and LOL tasks were significant predictors ($p < .01$) as was the R measure for the SOL tasks ($p < .05$). However, the relationship between the R measure for the SOL task and the combined cloze scores was significant at a lower level when the results on the Memory sub-test were considered. In spite of this one change, it appeared that the relationship between the free recall measures and the combined cloze scores for the total sample remained largely unchanged when the results on the Memory sub-test of the standardized test of mental maturity were considered.

The results of an analysis of the relationship between the free recall measures and the combined cloze scores for the total sample with the results of the Language sub-section of the standardized test of mental maturity considered is reported in Table XXXIV. It may be seen that in comparison to the results of a similar analysis without considering the results on the Non-language sub-section, as presented in Table XXVI, the probability values in Table XXXIV were somewhat higher. However, in both cases the N measure for the three types of free recall tasks and the R + RR and N + R + RR variables for the SOL and LOL tasks were significant predictors of the combined cloze scores ($p < .01$). But the relationship between the R measure for the SOL tasks and the combined cloze scores was no longer significant when consideration was given to the results of the Language sub-section and the relationship between the N measure for the ROL tasks and the combined

Table XXXIV

RELATIONSHIP BETWEEN FREE RECALL MEASURES AND COMBINED CLOZE SCORE FOR TOTAL SAMPLE WITH LANGUAGE RESULTS CONTROLLED

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	147	8.9522	0.00325	**
Semantic	R	1	147	1.2086	0.27331	NS
Semantic	RR	1	147	0.0651	0.79859	NS
Semantic	R+RR	2	146	7.0564	0.00877	**
Semantic	N+R+RR	3	145	9.9037	0.00200	**
Linguistic	N	1	147	8.2628	0.00465	**
Linguistic	R	1	147	0.0168	0.89668	NS
Linguistic	RR	1	147	2.1295	0.14656	NS
Linguistic	R+RR	2	146	9.0072	0.00316	**
Linguistic	N+R+RR	3	145	12.2207	0.00062	**
Random	N	1	147	4.7827	0.03031	*

** $p < .01$
* $p < .05$

cloze scores became significant at a lower level ($p < .05$). In spite of these differences, it would appear that the relationship between the free recall measures and the combined cloze scores for the total sample remained largely unchanged when the results on the Language sub-section of the standardized test of mental maturity were considered.

Summary

The findings of sections I and II are summarized below. Figure 7 presents a summary of the significance of the relationships between performance on the free recall tasks and the combined cloze scores as they have been reported in the previous sections. The findings below

FIGURE 7

SUMMARY OF THE SIGNIFICANCE OF THE RELATIONSHIPS BETWEEN PERFORMANCE ON FREE RECALL TASKS AND THE COMBINED CLOZE SCORES

Relationship Between Combined Cloze Scores and	Without Control	Variable Controlled								
				Reading Achievement			Mental Maturity			
		Age	Sex	Speed	Vocab.	Comp.	Memory	Non-Lang.	Lang.
N(SOL)	**	**	**	**	**	**	**	**	**
R(SOL)	**	*	**	*	**	*	*	**	NS
RR(SOL)	NS	NS	NS	NS	NS	NS	NS	NS	NS
R+RR(SOL)	**	**	**	**	**	**	**	**	**
N+R+RR(SOL)	**	**	**	**	**	**	**	**	**
N(LOL)	**	**	**	**	**	**	**	**	**
R(LOL)	NS	NS	NS	NS	NS	NS	NS	NS	NS
RR(LOL)	NS	NS	NS	NS	NS	NS	NS	NS	NS
R+RR(LOL)	**	**	**	**	**	**	**	**	**
N+R+RR(LOL)	**	**	**	**	**	**	**	**	**
N(ROL)	**	*	**	NS	**	*	**	**	*

** $p < .01$
* $p < .05$
NS = not significant

reflect the results summarized in Figure 7.

1. With the exception of the RR measure, all other measures of performance on the semantic free recall tasks were significant predictors of the combined cloze scores of the total sample.

2. With the exception of the R and RR measures alone, all other measures of performance on the linguistic free recall tasks were significant predictors of the combined cloze test scores of the total sample.

3. The N measure for the random free recall tasks was a significant predictor of the combined cloze scores for the total sample.

4. The relationship between the measures of performance on the free recall tasks and the combined cloze scores for the total sample was not greatly altered when consideration was given to the factors of age, sex, mental maturity and reading achievement.

Thus it would appear that the ability to recall lists of words organized according to certain semantic, linguistic and random criteria, as measured by the free recall task, was significantly related to the ability to read and comprehend written material, as measured by the cloze procedure.

III. Variations in the Relationship Between the Free Recall Measures and the Combined Cloze Scores Among Selected Variables

The design of the experiment called for the administration of three different types of free recall tasks, based upon three different reading articles, to six different groups of subjects. The preceding analysis in sections I and II did not explicitly take into consideration the possibility of differences occuring in the relationship between the

measures of free recall and the combined cloze scores for the total sample when the measures were based upon different types of free recall tasks, or the tasks were based upon different articles or were administered to different groups. This section examines the possibility of variations in the relationship between the free recall measures and the combined cloze scores among the variables of type of free recall task, article and group.

Variations Among the Three Types of Free Recall Tasks

It was indicated previously in the discussion of the subjects' performance on the free recall tasks that there was variation in their performance on the three different types of recall tasks. Consequently, it would appear desirable to examine the relationship between the free recall measures and the cloze test results in terms of the three types of recall tasks administered to the subjects.

Table XXVI which examined the relationship between the measures of free recall and the combined cloze scores for the total sample using multiple linear regression analysis provided some information pertinent to the question of the relative relationship of the measures of performance derived from the three types of recall tasks and the results of the cloze tests. An examination of the F-ratios and probability values appeared to indicate that the relationship with the cloze test results was strongest for the performance measures derived from the SOL tasks and particularly the N measure where an F-ratio of 37.2862 and a p value of < 0.00001 existed. The relative relationship between the measures of performance derived from the LOL and ROL tasks and the cloze test results was not clearly indicated in this table, however.

In order to examine further the question of possible differences in the relationship of the performance measures derived from the three types of recall tasks to the cloze test results, stepwise regression analysis was undertaken. All measures of performance for the three types of free recall tasks were used as predictors of the combined cloze scores for the total sample. The results appear in Table XXXV. It may be seen from this table that the N measure for the SOL tasks was a significant predictor ($p < .01$) of the combined cloze scores for the total sample and that the percentage of variance accounted for was 20.12%. The N measure for the ROL tasks was the second most significant predictor of the combined cloze scores for the total sample ($p < .05$) and raised the percentage of variance accounted for to 22.45%. None of the remaining measures of free recall added significantly to the percentage of variance accounted for beyond the N measures for the SOL and ROL free recall tasks.

Thus it would appear that the N measure for the SOL tasks was the most significant predictor of the combined cloze scores for the total sample and that the N measure for the ROL tasks was the second most significant predictor. None of the measures for the LOL tasks added significantly to the variance accounted for by these two measures. Differences in the subjects' performance on the three types of recall tasks seemed to be reflected in differences in the predictive power of measures derived from those tasks, with the semantic task providing the best predictor, the random task the second best and the linguistic task adding little for the total sample.

Table XXXV

STEPWISE LINEAL REGRESSION ANALYSIS OF THE PREDICTORS OF THE COMBINED CLOZE SCORES

Step No.	Source of Variance Added	F-ratio	p	Sign.of Variance Added	Per Cent Variance Predicted	Total Variance Predicted
#1	N(SOL)	37.2868	0.0001	**	20.12	20.12
#2	N(ROL)	4.4074	0.0375	*	2.33	22.45
#3	RR(SOL)	1.6572	0.2000	NS	0.87	23.32
#4	R(SOL)	1.8718	0.1733	NS	0.98	24.30
#5	N(LOL)	1.5490	0.2152	NS	.80	25.10
#6	RR(LOL)	0.1804	0.6716	NS	.10	25.20
#7	R(LOL)	1.3458	0.2579	NS	.70	25.90

** $p < .01$
* $p < .05$

Variations Among the Three Reading Articles

In addition to the three types of free recall tasks utilized in this study, three different reading articles were used as a basis for the construction of free recall lists and cloze tests of reading comprehension. It was reported in Table XII that subjects scored significantly lower on the cloze test based upon Article I than on the cloze test based upon Article II. The question may be asked whether or not the relationship between the measures of free recall and the results for the cloze tests varied with the articles used and, consequently, with the difficulty of the cloze test based upon the articles.

In order to answer this question, Groups I and IV, II and V and III and VI were combined as each pair of groups received the same type of free recall task based upon the same article. Correlation coefficients were calculated in order to determine the relationship between the measures of free recall and the cloze test results for the articles upon which the free recall lists were based for each of these three combined groups. The results are reported in Table XXXVI. In order to discover whether or not significant differences existed among the relationships between the different articles and the measures of free recall, Z tests of the variance of proportions were performed upon the correlation coefficients for each of the articles and each of the measures of free recall. The results of this analysis are reported in Table XXXVII.

Table XXXVI

CORRELATION COEFFICIENTS BETWEEN FREE RECALL MEASURES AND CLOZE TEST SCORES FOR THE THREE ARTICLES

TYPE		ARTICLES I		ARTICLES II		ARTICLES III
		Groups I & IV		Groups III & VI		Groups II & V
	N-	0.587**	N-	0.195	N-	0.482**
SOL	R-	0.164	R-	0.127	R-	0.357*
	RR-	-0.165	RR-	-0.007	RR-	0.171
		Groups II & V		Groups I & IV		Groups III & VI
	N-	0.267	N-	0.338*	N-	0.161
LOL	R-	-0.073	R-	0.178	R-	-0.138
	RR-	-0.189	RR-	0.093	RR-	-0.218
		Groups III & VI		Groups II & V		Groups I & IV
	N-	0.282*	N-	0.290*	N-	0.269

** $p < .01$
* $p < .05$

Table XXXVII

RESULTS OF Z TESTS OF THE VARIANCE OF PROPORTIONS BASED UPON THE CORRELATION COEFFICIENTS BETWEEN FREE RECALL AND CLOZE SCORES FOR EACH ARTICLE

		Groups I & IV	III & VI	II & V	VI
	Correlations	0.587	0.195	0.482	0.316
N(SOL)	0.195	2.302*			
	0.482	0.711	-1.590		
	0.316	1.338	-0.500	0.770	
		0.164	0.127	0.357	0.272
R(SOL)	0.127	0.185			
	0.357	-1.110	-1.195		
	0.272	-0.439	-0.587	0.367	
		0.165	-0.007	0.172	0.163
RR(SOL)	-0.007	-0.770			
	0.172	-1.647	-0.878		
	0.163	-1.281	-0.666	0.035	
		0.267	0.338	0.161	0.189
N(LOL)	0.338	-0.379			
	0.161	0.538	0.916		
	0.189	0.316	0.619	-0.113	
		-0.073	0.178	-0.138	-0.230
R(LOL)	0.178	-1.227			
	-0.138	0.318	1.545		
	-0.230	0.623	1.602	0.368	
		-0.189	0.093	-0.218	-0.332
RR(LOL)	0.093	-1.381			
	-0.218	0.150	1.531		
	-0.332	0.597	1.701	0.478	
		0.281	0.290	0.269	0.346
N(ROL)	0.290	-0.046			
	0.269	0.067	0.114		
	0.346	-0.275	-0.238	-0.329	

** $p < .01$
* $p < .05$

It may be seen from Table XXXVI that when Groups I and IV were combined a significant correlation coefficient of 0.587 existed between the N measure for the SOL tasks and the cloze test scores for Article I ($p < .01$). Non-significant correlation coefficients of 0.164 and -0.165 existed between the R and RR measures for the SOL tasks and the cloze test scores for Article I for the combined Groups I and IV. When Groups III and VI were combined none of the correlations between the measures of free recall for the SOL tasks and the cloze test scores for Article II were significant. When Groups II and V were combined, a significant correlation coefficient of 0.482 existed between the N measure for the SOL tasks and the cloze test scores for Article III ($p < .01$). In addition, the correlation coefficient of 0.357 between the R measure for the SOL tasks and the cloze test scores for Article III for combined Groups II and V reached the level of significance ($p < .05$). However, the correlation between the RR measure for the SOL task and the cloze test scores for Article III did not reach the level of significance for combined Groups II and V. These results tended to indicate the possibility of significant differences between the correlations as there was some variation.

The results for the three combined groups for the LOL tasks based upon the different articles indicated that only one correlation coefficient reached the level of significance. The correlation of 0.338 between the N measure for the LOL task and the results of the cloze test based upon Article II for the combined Groups I and IV was significant ($p < .05$). Significant correlations of 0.282 and 0.290 existed between the N measure for the ROL tasks and the cloze test scores based upon Articles I and II for combined Groups III and VI and II and V

respectively ($p < .05$). However, the correlation coefficient of 0.269 for combined Groups I and IV was not significant.

Table XXXVII presents the results of the Z tests of the variance of proportions for the correlations discussed above. A value of 1.96 was required for significance at the .05 level while a value of 2.58 was significant at the .01 level. It may be seen that only in one instance was the Z value significant. There was a significant difference between the correlation between the N measure for the SOL task and the cloze test scores for combined Groups I and IV and combined Groups III and VI as indicated by the Z value of 2.302. However, as indicated previously, Group III differed from the rest of the sample on variables which could have been pertinent to the findings in this study. Consequently, the significant difference indicated above could have been a function not of differences between the articles but of differences between the samples. If the difference was in fact attributable to the article, the difference should have remained when the correlation between the N measure for the SOL tasks and the cloze test scores based upon Article II for Group VI alone was compared with the corresponding correlation for combined Groups I and IV. However, the Z value of 1.338 for this comparison was no longer significant. This would appear to indicate that the original finding may have been a result of the inclusion of Group III in the sample. Thus it would appear that the relationship between the measures of performance for the free recall tasks and the cloze tests of reading comprehension did not vary significantly from one article to another even though the cloze test based upon Article I was significantly more difficult than the cloze test based upon Article II.

Table XXXVIII

CORRELATION COEFFICIENTS BETWEEN FREE RECALL MEASURES AND CLOZE TEST SCORES FOR INDIVIDUAL GROUPS

Groups	Articles					
	SOL	r	LOL	r	ROL	r
I	N-	0.527**	N-	0.143	N-	0.236
	R-	0.134	R-	0.199		
	RR-	-0.167	RR-	0.224		
	LOL	r	ROL	r	SOL	r
II	N-	0.354	N-	0.420*	N-	0.589**
	R-	-0.143			R-	0.571**
	RR-	-0.269			RR-	0.404*
	ROL	r	SOL	r	LOL	r
III	N-	0.208	N-	0.211	N-	0.002
			R-	0.023	R-	0.136
			RR-	0.089	RR-	0.058
	SOL	r	LOL	r	ROL	r
IV	N-	0.645**	N-	0.453*	N-	0.298
	R-	0.170	R-	0.091		
	RR-	-0.207	RR-	-0.115		
	LOL	r	ROL	r	SOL	r
V	N-	0.196	N-	0.154	N-	0.360
	R-	0.007			R-	0.060
	RR-	-0.207			RR-	-0.152
	ROL	r	SOL	r	LOL	r
VI	N-	0.346	N-	0.316	N-	0.189
			R-	0.272	R-	-0.230
			RR-	0.163	RR-	-0.332

** $p < .01$
* $p < .05$

<u>Variations Among the Groups</u>

In addition to the three different types of recall tasks and the three different articles used in the study, the sample was composed of six different groups each of which received a different treatment. The question may be asked whether or not the relationship between the measures of free recall and the cloze test results differed significantly from one group to another. In order to consider this question, correlation coefficients were calculated between the free recall and the cloze test results for each of the groups. To find out if significant differences existed between the correlation coefficients for the different groups, Z tests of the variance of proportions were used to compare the coefficients. The results of this analysis may be found in Tables XXXVIII and XXXIX.

A perusal of the correlation coefficients in Table XXXVIII indicated the possibility of significant differences from group to group. It may be seen that in the case of Groups III, V and VI none of the correlations reached the level of significance. However, the correlation between the N measure for the SOL task and the cloze test scores for Groups V and VI approached the level of significance as did the correlation between the N measure for the ROL task and the cloze test scores for Group VI. In addition, the R and RR measures for the SOL task were significantly correlated with the cloze test scores for Group II but for no other group.

Table XXXIX presents the results of the Z tests performed upon the correlation coefficients. Values of 1.96 and 2.58 were required for significance at the .05 and .01 levels, respectively. It may be

Table XXXIX

RESULTS OF Z TESTS OF THE VARIANCE OF PROPORTIONS BASED UPON THE CORRELATION COEFFICIENTS BETWEEN FREE RECALL AND CLOZE SCORES FOR EACH GROUP

		Groups					
		I	II	III	IV	V	VI
		Correlations					
		0.527	0.589	0.211	0.645	0.360	0.316
	0.589	-0.300					
	0.211	1.231	1.531				
N(SOL)	0.645	-0.603	-0.303	-1.834			
	0.360	0.693	0.993	-0.538	1.296		
	0.316	0.858	1.158	-0.373	1.461	0.165	
		0.134	0.572	0.023	0.167	0.060	0.272
	0.571	-1.710					
	0.023	0.372	2.081*				
R(SOL)	0.170	-0.122	1.588	-0.494			
	0.060	0.247	1.957	-0.125	0.369		
	0.272	-0.479	1.231	-0.851	-0.357	-0.726	
		-0.167	0.404	-0.089	-0.207	-0.152	0.163
	0.404	-1.979*					
	-0.089	-0.261	1.717				
RR(SOL)	-0.207	0.138	2.117*	0.399			
	-0.152	-0.051	1.928	0.211	-0.189		
	0.163	-0.105	0.874	-0.843	-1.243	-1.054	
		0.143	0.354	0.002	0.453	0.196	0.189
	0.354	-0.751					
	0.002	0.470	1.221				
N(LOL)	0.453	-1.144	-0.393	-1.614			
	0.196	-0.182	0.569	-0.652	0.962		
	0.189	-0.160	0.592	-0.630	0.984	0.022	
		0.199	-0.143	0.136	0.091	0.007	-0.230
	-0.143	1.148					
	0.136	0.215	-0.933				
R(LOL)	0.091	0.365	-0.782	0.151			
	0.007	0.647	-0.501	0.432	0.281		
	-0.230	1.445	0.297	1.230	1.080	0.798	
		0.224	-0.269	0.058	-0.1154	-0.075	-0.332
	-0.269	1.671					
	0.058	0.564	-1.107				
RR(LOL)	-0.115	1.140	-0.531	0.576			
	-0.075	1.007	-0.665	0.442	-0.134		
	-0.332	1.902	0.231	1.338	0.762	0.895	
		0.236	0.420	0.208	0.298	0.154	0.346
	0.420	-0.687					
	0.208	0.098	0.785				
	0.298	-0.219	0.468	-0.317			
	0.154	0.284	0.971	0.186	0.503		
	0.346	-0.396	0.291	-0.494	-0.177	-0.680	

** $p < .01$ * $p < .05$

seen from the table that only three of the Z values reached the level of significance. A significant difference existed between the correlation between the RR measure for the SOL task and the cloze test scores for Groups II and I and Groups II and IV ($p < .05$). A significant difference existed between the correlation between the R measure for the SOL task and the cloze test scores for Groups II and III ($p < .05$) while the difference between Groups II and V approached significance. None of the other comparisons between the correlation coefficients reached the level of significance.

Thus it would appear that the only differences between the correlations between the free recall measures and the cloze test scores for each of the groups that reached the level of significance may be atrributed to the abnormally high correlations between the R and RR measures for the SOL task and the cloze test scores based upon Article III for Group II. With this exception, the relationship between the free recall measures and the cloze test scores did not appear to vary significantly from one group to another.

Summary

In summary form, the findings of section III appear to be as follows:

1. Measures of performance derived from the semantic free recall tasks appeared to be better predictors of the combined cloze scores of the total sample than measures of performance derived from the random free recall tasks which, in turn, seemed to be better predictors of the combined cloze scores than measures of performance derived from the linguistic free recall tasks.

2. The relationship between the measures of performance for the free recall tasks and the cloze test results did not vary significantly from one reading article to another.

3. The relationship between the measures of performance on the free recall tasks and the cloze test results did not vary significantly from one group of subjects to another with one exception. The exception involved abnormally high correlations for Group II between the R and RR measures for the SOL task and the cloze test results based upon Article III.

IV. The Effects of Memory Task Variants Upon the Relationship Between the Measures of Free Recall and the Cloze Test Results

Two variants of the memory task were utilized in this study. The SOL task based upon Article II was found to be capable of being scored in an alternate fashion. In addition, each group received a delayed free recall task. The question may be asked how these variants of the memory task affected the relationship between the measures of free recall and the cloze test results. This section examines this question.

Alternate Semantic Scoring

As stated in Chapter III, the results of the categorizing of the semantically organized list of stimulus words based upon Article II by a panel of judges indicated that there were two possible methods of categorizing these words. Thus the possibility existed of two different bases for organization in recall. Consequently, the protocols of Groups III and VI which received this SOL list were scored using both possible organizations. This section examines the predictive power of these

alternate SOL task scores

The results of multiple linear regression analysis utilizing the free recall measures derived from the alternate scoring of the SOL task for combined Groups III and VI as predictors of both the combined cloze test scores and the results for the cloze test based upon Article II are reported in Table XL. It may be seen that none of the measures

Table XL

RELATIONSHIP BETWEEN FREE RECALL RESULTS FOR ALTERNATE SEMANTIC SCORING AND CLOZE TEST RESULTS FOR COMBINED GROUPS III AND VI ON ARTICLE II

Score	Cloze Test	df.num.	df.denom.	F-ratio	p	Sign.
N	II	1	48	1.9003	0.17442	NS
R	II	1	48	0.0218	0.88330	NS
RR	II	1	48	0.6101	0.43853	NS
R+RR	II	2	47	1.2596	0.29313	NS
N+R+RR	II	3	46	0.8691	0.46391	NS
N	Comb.	1	48	2.3391	0.13271	NS
R	Comb.	1	48	0.0010	0.97469	NS
RR	Comb.	1	48	1.2974	0.26030	NS
R+RR	Comb.	2	47	2.1258	0.13065	NS
N+R+RR	Comb.	3	46	1.3913	0.25739	NS

** $p < .01$
* $p < .05$

or combinations of measures was a significant predictor of the cloze test results for combined Groups III and VI

The above results may be compared to those reported in Table XXXVI which indicated the correlations between the free recall measures for the SOL task and the cloze test results for combined Groups III and VI using

the original basis of organization for scoring the free recall protocols. It may be seen that none of the correlations in Table XXXVI were significant. Thus it would appear that the alternate method of scoring the semantic free recall protocols based upon Article II did not greatly affect the relationship between the semantic free recall measures and the cloze test results for combined Groups III and VI.

Delayed Free Recall Tasks

One delayed free recall task was administered to each group based upon Article III. This section presents the results of an analysis of the relationship between the results of the delayed free recall tasks and the results of the cloze tests of reading comprehension. The pairs of groups which undertook the same type of delayed free recall task, that is, Groups I and IV, II and V, and III and VI, were combined and multiple linear regression equations were written using the measures derived from the delayed free recall tasks as predictors of both the cloze test results based upon Article III and the combined cloze scores. The results of the analysis are reported in Tables XLI, XLII and XLIII.

Table XLI

RELATIONSHIP BETWEEN DELAYED RANDOM RECALL MEASURES AND CLOZE TEST RESULTS FOR COMBINED GROUPS I AND IV

Score	Cloze Test	df.num.	df.denom.	F-ratio	p	Sign.
N	III	1	48	10.7222	0.00197	**
N	Comb.	1	48	12.1741	0.00105	**

** $p < .01$
* $p < .05$

Combined Groups I and IV undertook a delayed random free recall task based upon Article III. Table XLI reports the results of analysis using the N measure for the delayed ROL task for combined Groups I and IV, as a predictor of the results of the cloze test for Article III and the combined cloze scores. It may be seen that the N measure for the delayed ROL task was a significant predictor of both cloze test results ($p < .01$). When these results were compared to those in Table XXXVI for the N measure for the immediate random free recall task for

Table XLII

RELATIONSHIP BETWEEN DELAYED SEMANTIC RECALL MEASURES AND CLOZE TEST RESULTS FOR COMBINED GROUPS II AND V

Score	Cloze Test	df.num.	df.denom.	F-ratio	p	Sign.
N	III	1	48	14.8274	0.00035	**
R	III	1	48	5.9737	0.01824	*
RR	III	1	48	0.8483	0.36159	NS
R+RR	III	2	47	10.1695	0.00031	**
N+R+RR	III	3	46	6.6355	0.00081	**
N	Comb.	1	48	13.1054	0.00071	**
R	Comb.	1	48	6.0769	0.01732	*
RR	Comb.	1	48	0.6405	0.42743	NS
R+RR	Comb.	2	47	9.4494	0.00036	**
N+R+RR	Comb.	3	46	6.1819	0.00128	**

** $p < .01$
* $p < .05$

combined Groups I and IV, it may be seen that in the case of the immediate recall task the correlation coefficient of 0.269 between the N measure and the results of the cloze test based upon Article III was not significant. Thus it would appear that the relationship between the N

measure for the delayed random free recall task and the cloze test results was significant for combined Groups I and IV while the relationship between the N measure for the immediate random free recall task and the cloze test results for combined Groups I and IV did not reach the level of significance.

The results of an analysis using multiple linear regression of the relationship between the measures for the delayed semantic free recall task and the results of the cloze test based upon Article III and the combined cloze results for combined Groups II and V are reported in Table XLII. It may be seen from this table that the N, the R + RR and the N + R + RR variables for the delayed semantic free recall task

Table XLIII

RELATIONSHIP BETWEEN DELAYED LINGUISTIC RECALL MEASURES AND CLOZE TEST RESULTS FOR COMBINED GROUPS III AND VI

Score	Cloze Test	df.num.	df.denom.	F-ratio	p	Sign.
N	III	1	48	0.6684	0.41759	NS
R	III	1	48	0.1468	0.70329	NS
RR	III	1	48	0.0540	0.81723	NS
R+RR	III	2	47	0.0796	0.92359	NS
N+R+RR	III	3	46	0.2419	0.86659	NS
N	Comb.	1	48	1.0159	0.31849	NS
R	Comb.	1	48	1.3121	0.25768	NS
RR	Comb.	1	48	0.5035	0.48140	NS
R+RR	Comb.	2	47	0.7009	0.50125	NS
N+R+RR	Comb.	3	46	0.5705	0.63726	NS

** $p < .01$
* $p < .05$

were significant predictors of both the cloze test results based upon Article III and the combined cloze scores for combined Groups II and V ($P < .01$). Furthermore, the R measure for the delayed free recall task was also a significant predictor of the cloze test results for combined Groups II and V ($p < .05$). However, the RR measure was not a significant predictor of the cloze test results.

When the above results were compared to those presented in Table XXXVI for the immediate semantic free recall task for combined Groups II and V it appeared that the two set of results were comparable. In both cases the N measure was a significant predictor of the cloze test results for Article III ($p < .01$) as was the R measure ($p < .05$) while the RR measure was not a significant predictor. Thus it would appear that the relationship between the delayed semantic free recall task and the cloze test results was comparable to the relationship between the immediate semantic free recall measures and the cloze test results for combined Groups II and V.

The results of an analysis of the relationship between the measures derived from the delayed linguistic free recall task for combined Groups III and VI and the results of the cloze test based upon Article III and the combined cloze scores is reported in Table XLIII. It may be seen that in no case did the relationship reach the level of significance. These results are comparable to those for combined Groups III and VI for the immediate linguistic free recall task as presented in Table XXXV. Thus it would appear that the relationship between the delayed linguistic free recall task measures and the cloze test results for combined Groups III and VI did not differ greatly from the relationship between the immediate linguistic free recall task measures and the cloze test results

for the same sample.

The above findings appeared to indicate that the relationship between the delayed semantic and linguistic free recall tasks and the cloze test results did not differ greatly from the relationship between the immediate semantic and linguistic free recall tasks and the cloze test results. However, the relationship between the delayed random free recall task and the cloze test results appeared to be significant at a higher level than the relationship between the immediate random free recall task and the cloze test results. It must be remembered, however, that the delayed tasks involved an interval of only four minutes.

A possible explanation for the above results may be as follows. Since the random task was constructed to exhibit no basis for organization known to the experimenter, although that does not mean that no basis for organization existed, it could be that the delay allowed subjects an opportunity to discover or create a basis for organization. However, with the semantic task that basis may have been obvious to those subjects who did exhibit organization in their free recall and so the additional time was not required. In the case of the linguistic basis for organization it could be that few students were able to impose organization upon the lists even after the delayed task. However, this explanation is considered to be only a suggestion and no proof was available from this study to support it.

Summary

In summary form, the results of section IV appeared to be as follows:

1. The alternate method of scoring the semantic free recall protocols for Groups III and IV based upon Article II did not greatly affect the relationship between the measures of performance on this free recall task and the cloze test results.

2. The relationship between the N measure for the delayed random free recall task and the cloze test results for combined Groups I and IV was significant while the relationship between the N measure for the immediate free recall task and the cloze test results for the same groups did not reach the level of significance.

3. The relationship between the delayed semantic free recall task results and the cloze test scores appeared to be comparable to the relationship between the immediate semantic free recall results and the cloze test scores.

4. The relationship between the delayed linguistic free recall task results and the cloze test scores appeared to be comparable to the relationship between the immediate linguistic free recall task results and the cloze test scores.

V. Relationship Between the Standardized Memory Test Results, the Free Recall Results and the Cloze Test Scores

One of the reasons previously stated for the selection of the *California Test of Mental Maturity* as the standardized measure of mental ability in this study was the fact that this test includes a section labelled Delayed Recall. It was felt that it might prove interesting to examine the relationship between the scores achieved on this standardized test of memory and those achieved on the free recall tasks. Furthermore, the relationship between the results of the standardized

test of Delayed Recall and the cloze test scores was also explored. This section presents the results of that analysis.

Multiple linear regression equations were written using the measures derived from the free recall tasks, that is, the N, R and RR measures, as predictors of the Delayed Recall results. This analysis is reported in Table XLIV. It may be seen that the N measure for the SOL tasks was a significant predictor of the Delayed Recall results for the total sample ($p < .01$), as was the N measure for the ROL tasks ($p < .05$). In all other cases the relationship did not reach the level of significance. However, it should be remembered that, according to the results presented in Table XXXV, the N measures for the SOL and ROL tasks were the only significant predictors of the combined cloze scores for the total sample as indicated by stepwise regression analysis.

Table XLIV

RELATIONSHIP BETWEEN FREE RECALL RESULTS AND
STANDARDIZED MEMORY TEST RESULTS
FOR COMBINED SAMPLE

Type	Score	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	N	1	148	18.4714	0.00003	**
Semantic	R	1	148	3.3353	0.06980	NS
Semantic	RR	1	148	0.1981	0.65680	NS
Linguistic	N	1	148	2.0301	0.15631	NS
Linguistic	R	1	148	0.2053	0.65113	NS
Linguistic	RR	1	148	0.0290	0.86505	NS
Random	N	1	148	4.3925	0.03779	*

** $p < .01$
* $p < .05$

Table XLV examines the correlation coefficients between the results of the standardized Delayed Recall test and both the experimental and standardized measures of reading used in the study. It may be seen that in all cases the correlations reached the level of significance

Table XLV

CORRELATION COEFFICIENTS BETWEEN STANDARDIZED DELAYED RECALL TEST AND MEASURES OF READING FOR THE TOTAL SAMPLE

Variable	Correlation	Significance
Cloze I	0.536	**
Cloze II	0.463	**
Cloze III	0.479	**
Combined Cloze	0.533	**
Speed and Accuracy	0.447	**
Vocabulary	0.516	**
Comprehension	0.580	**

** $p < .01$
* $p < .05$

($p < .01$). The highest correlation was 0.580 between the Delayed Recall results and the Comprehension section of the Gates-MacGinitie Reading Test while the lowest was 0.447 between the Delayed Recall results and the Speed and Accuracy section of the same test.

Thus, it would appear that the results of the standardized test of memory were significantly correlated with the measures of reading utilized in this study. However, the relationship between the Delayed Recall scores and the experimental measures of free recall was not

significant at as high a level as might be expected of two tests which purport to measure the same ability. Furthermore, in the light of the criticism of the standardized Delayed Recall test by Stanley (Buros, 1965) the relationship between the standardized memory test results and the cloze test results must be interpreted cautiously. It may be that a significant relationship existed because of the heavy emphasis upon reading in the completion of the Delayed Recall Test.

VI. Inter-relationship Among the Three Measures of Performance on a Free Recall Task

As indicated previously, three measures were derived for the SOL and LOL free recall tasks. These measures were the N score, the R score and the RR score. These three measures were first used by Bousfield (1953) and have remained in common usage since that time. According to Bousfield the R and RR measures are indicative of the subject's organization in free recall.

In all instances in this study in which the three measures of free recall have been utilized as predictors of the cloze test results, the N measure has proven to be a better predictor than either the R or RR measures. This was particularly evident in Table XXXV where the stepwise regression analysis indicated that while the N measure for the SOL tasks was a significant predictor of the combined cloze scores for the total sample, neither the R nor the RR measures were significant predictors.

The fact that the R and RR measures for the semantic free recall task did not contribute significantly to the prediction of the variance of the cloze test scores above and beyond the variance predicted by the

N measure raised the question of the validity of these two measures. It will be remembered that the N measure was simply the total number of words correctly recalled. The R measure was the number of words recalled in clusters and was obtained by counting all of the words from a single category recalled in contiguity, subtracting one and adding all such scores for a protocol. The RR measure represented the proportion of words recalled in clusters to the total number of words recalled. The formula for the RR scores is as follows:

$$RR = \frac{r}{N-1}$$

While Bousfield considered the R and RR measures to be indicative of organization in free recall, it has also been shown that as organization increased, as represented by the R and RR measures, so did the total number of words recalled, or the N measure. This may indicate that the N measure was not independent of the R and RR measures. That is, the total number of words recalled may also be an expression of organization in free recall.

In order to examine the inter-relatedness of the three measures of performance on the free recall tasks, multiple linear regression models were written using the R and RR measures separately and combined as predictors of the N measure, for both the SOL and LOL free recall tasks for the total sample. The results are reported in Table XLVI. It may be seen that both the R and RR variables were significant predictors of the N measure for both the SOL and LOL free recall tasks ($p < .01$). The RR measure was a significant predictor of the N measure for the SOL tasks ($p < .05$) but the relationship did not reach the level

Table XLVI

RELATIONSHIP AMONG THE THREE MEASURES FOR THE SEMANTIC AND LINGUISTIC FREE RECALL TASKS FOR THE TOTAL SAMPLE

Type	Measure	df.num.	df.denom.	F-ratio	p	Sign.
Semantic	R	1	148	104.5942	0.00001	**
Semantic	RR	1	148	6.4763	0.01195	*
Semantic	R+RR	2	147	258.6755	0.00001	**
Linguistic	R	1	148	36.3498	0.00001	**
Linguistic	RR	1	148	1.9481	0.16486	NS
Linguistic	R+RR	2	147	91.2327	0.00001	**

** $p < .01$
* $p < .05$

of significance for the LOL tasks.

Thus it would appear that the possibility existed that the N measure was in fact measuring the same ability as the R and RR measures, that is, the ability to impose organization upon stimuli which is to be retained. It may also be possible that the N score may be measuring other abilities involved in memory in addition to organization. However, no evidence was available to support this possibility.

VI. Summary

This chapter has described the analysis of the relationship between the measures of performance on the free recall tasks and the cloze test results. The findings, in summary form, appear to be as follows.

A significant relationship existed between the measures of performance on the free recall tasks and the results of the test of reading

comprehension for the total sample. This relationship was not altered appreciably when consideration was given to the factors of age, sex, mental maturity and reading achievement as they pertained to the sample. However, the relationship between the measures of performance on the free recall tasks and the cloze test results did vary with the measure of performance examined and the type of free recall task from which the measure was derived. Furthermore, the relationship between the measures of performance on the free recall tasks and the cloze test results did not appear to vary greatly from one article to another nor, with one exception, from one group to another.

The relationship between the measures derived from the alternate method of scoring the semantic free recall task based upon Article II for combined Groups III and VI and the cloze test results was not significant at a higher level than the relationship between the measures of performance derived from the original method of scoring the SOL task and the cloze test results. While the results of the delayed SOL and LOL free recall tasks did not appear to be more significantly related to the cloze test results than did the measures derived from the immediate SOL and LOL tasks, it appeared that the results of the delayed random free recall task were significantly related on a higher level to the cloze test results than the measures derived from the immediate random free recall task.

The results of the standardized test of memory, while significantly related to the standardized and experimental reading test results, may not have been as significantly related to the results of the free recall tasks as might have been expected of two tests which purport to measure the same ability, that is, memory. The three measures of

performance on the free recall tasks appeared to be highly interrelated. This may cast doubt upon the validity of the R and RR measures.

CHAPTER VIII

AN EXAMINATION OF SELECTED INDIVIDUAL PROFILES AND SELECTED CLOZE TEST RESPONSES

The analysis of the role of memory in reading comprehension has involved, to this point, a theoretical discussion of the possible involvement of memory in reading comprehension and a statistical analysis of the relationship of the results of free recall memory tasks and those of cloze tests of reading comprehension. Statistical relationships were found to exist which tended to support the general notion developed in the theortetical discussion that memory plays a vital role in comprehension and that the nature of such involvement was linked with the concept of organization in memory processes.

In order to explore further the role of memory in reading comprehension, two additional forms of analyses were undertaken. The first consisted of an examination of the profiles of three selected subjects to gain some indication of the applicability of the group results to individual subjects. The second type of analysis consisted of an examination of selected student responses to the cloze tests for indications of the operation of memory in comprehension. It was felt that the inclusion of these two additional forms of analysis, the first of a clinical nature and the second of a qualitative nature, not only complemented the statistical analysis of this study but could also provide suggestions for viable techniques for later research into memory and reading comprehension. Chapter VIII reports the results of these additional forms of analyses.

I. An Examination of Selected Individual Profiles

The preceding statistical analysis has indicated the existence of significant relationships between the measures of performance on the free recall tasks and the cloze test results for the total sample. The question may be raised as to the applicability of these findings to individual subjects within the sample. To gain some indication of the results of individual subjects, the profiles of three students were selected and are discussed below.

Three sub-groups were drawn from the total sample on the basis of the combined cloze scores. The three sub-groups consisted of those subjects who scored in approximately the top five percent, the middle five percent and the bottom five percent of the total sample on the combined cloze score. There were seven or eight subjects in each group. One student was chosen at random from each of the sub-groups and the results of these three subjects on the experimental tasks were reported in Table XLVII.

It may be seen from Table XLVII that the student from the top group scored higher than the student from the middle group who, in turn, scored higher than the student from the low group on all three cloze tests. Since the criterion score used to select the individuals was the combined cloze score and since it has already been shown that there were high correlations among the cloze test results, this ordering may not be surprising.

The student from the top group recalled more words and achieved higher R and RR scores on the SOL task than either of the other two subjects. The top student recalled fifteen words with an R score of five and an RR score of .36. This seemed to confirm the significant relationship

Table XLVII

INDIVIDUAL PROFILES OF SELECTED SUBJECTS

	Cloze Scores				Free Recall Scores						
					SOL			LOL			ROL
Group	C.C.	Cl.I	Cl.II	Cl.III	N	R	RR	N	R	RR	N
Top	279	80	90	109	15	5	.36	9	1	.13	5
Mid	202	64	65	73	9	2	.25	10	1	.11	12
Low	70	19	24	27	12	1	.09	7	1	.17	7

C.C. = combined cloze score

reported previously between the N and R measures for the SOL task and the cloze test results.

However, the student from the low group recalled twelve words from the SOL task while the student from the middle group recalled only nine. In spite of this difference, the subject from the middle group achieved an R score of two and an RR score of .25, both of which were higher than the scores achieved by the subject from the low group. This may indicate that the subject from the middle group imposed a greater degree of organization upon those words which he did recall than the subject from the low group.

The student from the middle group recalled ten words from the LOL task while the students from the top and low groups recalled nine and seven words respectively. The differences between the number of words recalled from the LOL lists were not as great as the differences between

the number of words recalled from the SOL lists. All three subjects achieved R scores of one on the LOL task and did not appear to vary greatly on the RR measure. The highest RR score was .17 while the lowest was .11. This seemed to confirm the finding reported earlier that the relationship between the R and RR measures for the LOL task and the cloze test results did not reach the level of significance.

The student from the middle group recalled the greatest number of words from the ROL list, a total of twelve, while the student from the top group recalled only five words from the ROL list. The student from the low group recalled seven words from the ROL list.

It will be remembered that the ROL lists had not been pre-organized by the researcher. However, the possibility existed that the subjects and particularly the subject from the middle group, may have imposed their own individual schemes of organization upon the lists. In order to investigate this possibility the free recall protocols for the ROL lists for the three subjects were searched for evidence of possible individual schemes of organization in memory processes.

The recall protocols for each of the three subjects is presented below in Figure 8. No scheme of organization in the recall of the subject from the middle group was obvious. However, the two words "all" and "day", and the three words "air", "cold" and "temperature" may possibly have formed clusters in the subject's recall. These words appeared together in the recall of the subject and could possibly be related in some way. The subject from the top group, who recalled only five words from the ROL list, recalled the last three words from the presented list in the first three positions in recall. This ordering effect may indicate that this subject attempted to retain the list in a

FIGURE 8

FREE RECALL PROTOCOLS FOR SELECTED STUDENTS
IN RESPONSE TO ROL LISTS

Top Student	Mid Student	Low Student
dense	is	fisherman
moving	all	mushroom
no	day	the
see X	we	that
temperature	air	large
night	cold	pak
dark X	temperature	of X
them X	dense	oriagnat X
doing X	red	many X
	scatter	large X
	no	is X
	and	meam X
		helps

X indicates error response

rote fashion rather than attempting to impose organization upon the verbal items. In addition, the subjects from the top and low groups made four and six errors respectively while the subject from the middle group made no errors. Thus some differences appeared to be evident in the recall of the ROL lists by the three subjects.

The RR scores for the SOL tasks ranged from .36 to .09 while those for the LOL tasks ranged from .17 to .11, thus confirming the conclusion that subjects appeared to exhibit clustering in response to the SOL task but not in response to the LOL task. While there was some variation in the total number of words recalled, both the student from the top group and the student from the low group recalled most words in response to the SOL tasks.

This brief examination of the results of three subjects selected from the top, middle and low five percent of the total sample on the basis of the combined cloze scores appeared to indicate that the findings reported earlier for the large group seemed to be reflected in the individual profiles examined. Furthermore, the protocols have also indicated the existence of individual differences in spite of confirming the findings for the group, thus indicating the need for further intensive investigation of the memory processes of individual readers, possibly using a clinical technique.

II. An Examination of Selected Cloze Test Responses

Student's responses to the cloze tests of reading comprehension were carefully read and examples were noted which tended to both support and illustrate the findings of the theoretical discussion and of the statistical analysis. These examples appeared to indicate suggestions

about the nature of memory involvement in comprehension. This section reports the results of this analysis.

Subjects' responses are quoted throughout this section. Correct responses to blanks in the cloze test are underlined only, while incorrect responses are followed by the correct item enclosed in brackets. An underlined blank space indicates that the subject failed to provide any response.

A note of caution is required prior to the discussion. While the cloze procedure is an acceptable method of measuring a subject's reading comprehension skill and while it has been shown that a high correlation existed in this study between the results of the cloze tests and the standardized reading test results, it must be remembered that the the cloze procedure creates a reading situation which is somewhat artificial. The inclusion of blanks in the place of words interrupts the natural reading comprehension processes. This interruption is made in order to try to study the processes involved. It was assumed for the purposes of this analysis that the cloze procedure does not grossly distort the processes involved in reading comprehension.

The examination of the cloze responses appeared to provide ample indication of the importance of memory processes in reading comprehension. It would seem that there is a continuity and repetitiveness or "cumulativeness" in the connected discourse of written language. Topics are introduced as the subject of the discourse, discussed, and the discussion leads logically to the consideration of related topics which in turn come under discussion. This represents a type of language redundancy. Language is not a series of isolated units but rather an inter-connected network.

If the processor of the verbal stimulus is to follow the interconnected flow of the discourse in order to obtain a message, then he must not deal with a single verbal item as an isolated unit, but rather must deal with a multiplicity of related units at any given moment. However, both space and time intervene between the reader's perception of related units on a page. Consequently preceding material must be retained in the mind of the processor in some form or other and recalled in order to provide a psychological counterpart to the continuity present in written discourse. Memory must provide a means of enabling the reader to deal with the cumulativeness of written discourse, and the examination of the cloze responses provided examples which seemed to support this concept.

The cumulativeness of language was exhibited in the simple example which follows.

> "The cloud is greater <u>than</u> the sun," said the stonecutter, who was now the <u>sun</u>.

It would appear probable that the subject was aware of the previous mention of "sun" when he completed the second blank. Not only would such awareness enable the subject to complete correctly the blank, but would appear to be required in order to comprehend the significance of the complete statement. The speaker of the statement, the stonecutter, who has been transformed into the sun, was expressing an opinion or motive which led to another change in state. The stonecutter became the cloud. Thus it was necessary for the reader to relate the opinion stated in the first part of the example to the current state of the stonecutter as indicated at the end of the example in order to comprehend the message. The reader must be able to retain information presented at

different points in the passage in order to inter-relate information if the message is to be understood.

The following example indicated a violation of the demands made upon memory in the comprehension of written material.

> Rain could not wash me (him) away, and he was no longer discontented.

The inclusion of the error "me" in place of the pronoun "him" may have indicated that the subject did not note and retain the following pronoun "he" and/or did not relate it to the previous part of the statement. Such an act would require memory since the different parts of the message were encountered at different places on the printed page. It was difficult to ascertain accurately the severity of the error for comprehension. However, if the student believed that the two parts of the message actually pertained to two different individuals, that is, "me" and "he", it was obvious that the connection between the parts of the message would be lost and comprehension would be virtually impossible.

A more lengthy example provided ample indication of the cumulativeness of written discourse and the need for a psychological counterpart to this inter-relatedness if comprehension was to ensue.

> One of these places is Dawson, a city in north (northwest) Canada, several hundred miles south of Herschel Island. In Dawson the thermometer sometimes drops to 65 below zero. Yet it (Dawson) is an ordinary town where people live all the year round.

As this example indicated, "Dawson", first introduced as the object of a statement later became the subject of two statements. The first sentence dealt with location twice and the idea of a "city" or "town" was evident near the beginning and the end of the example. Thus

the passage was inter-related by a number of thematic threads that operated over time and space.

It was interesting that the student quoted above was able to fill in the first blank requiring the word "Dawson" and that he later responded with an incorrect stylistic variant of this reponse, the pronoun "it". In addition, while "north" was an incorrect response, it pertained to location which was required by the cues present in the remainder of the message. Thus it may be seen that discourse is interconnected and memory is required in order to take advantage of this cumulativeness and that only through the understanding of the relationship between information presented in different parts of the passage can comprehension be complete.

An additional example may be of interest since it may make explicit the manner in which the cloze procedure interrupts the comprehension process.

> There <u>would</u> be no fire, for <u>fire</u> (burning) occurs only if oxygen <u>is</u> present.

The inclusion of the incorrect response "fire" in place of "burning" indicated that the subject probably understood the message conveyed in the statement and therefore was able to provide a word which did not break the flow of the ideas presented. However, in an actual reading situation the presence of the word "burning" may provide additional perceptual information which would enable the reader to modify slightly his conceptual view of the message.

That memory plays a vital role in reading comprehension seemed to be indicated by the results of the statistical analysis and the examination of the cloze responses. However, the question may be asked in

what manner memory operates in reading comprehension? The review of the literature presented in Chapter II set forth a theoretical view concerning how memory operates in the retention of meaningful material. The notion that information could be retained rotely in the form in which it was presented to the individual was rejected on the grounds that humans can retain only a limited number of discrete pieces of information. Instead the twin concepts of unitizing and hierarchical recoding as first put forward by Miller (1956) were explored as possible explanations of the manner in which memory operates on stimuli such as a written message. It will be remembered that the unitizing concept referred to the ability of the individual to organize material into cohesive "chunks" while the recoding concept referred to the ability of the individual to change the form or code in which information was presented in a manner which made each item informationally richer through a process of abstraction. The examination of the cloze responses tended to support the notion that the concept of unitizing and recoding offer plausible explanations for the manner in which memory operates in reading comprehension.

Not only is language cumulative, but it would appear that language may potentially be organized into units which are internally coherent and which relate to surrounding units. These units appear to convey ideas both within themselves and in conjunction with other units. Memory must not only operate within units but also across units to form higher order units if there is not to be a break in the continuity and sequence of the flow not only of language as a vehicle but also of the ideas conveyed through language. This would appear to involve the process of unitizing as put forward by Miller (1956).

The example quoted below may indicate an ability on the part of the subject to form two internally consistent units or chunks but an inability to form a single higher order unit which would encompass both of the previous units.

> The people were (hid) from the fierce
> beams of this burning sun.

The above example appeared to reveal two units or chunks with a clear break after the incorrect response "were". The subject appeared unable to form one unit of the two parts of the message, a unit which would account for all of the information presented over the whole statement. This may involve both the unitizing and recoding abilities. Thus the error may involve, at least in part, a breakdown in memory processes.

The example provided below seemed similarly to involve an inability on the part of the subject to recode the parts of the message into one coherent unit or chunk.

> However, there's (Greenland), a big island
> in the Arctic, is covered with huge (large)
> masses of ice, called glaciers.

It would appear that there was a definite break after the word "Arctic". Both of the units preceding and following the break conveyed coherent ideas within themselves, but did not appear to form a single larger unit. This may have affected the comprehension of the complete statement since it failed to indicate the relationship between the parts. It was interesting that the student appeared to have ignored the punctuation of the sentence in making his responses.

An additional example may be given of a student who created meaningful units but who failed to note the punctuation of the sentence and consequently did not create a single complete thought.

> It was hard work, but the stonecutter was happy Then (until) one day when he saw the king ride by.

In this instance the student even attempted to create a new sentence by the inclusion of a capital letter beginning the word "Then". This subject appeared to be unwilling to think within the confines of the information presented.

A further example indicated that the subject may have carried forward two ideas to create a new idea. This cumulativeness of ideas would appear to involve memory.

> I have listened to the whistling of the birds (wind) and the howling of coyotes (wolves) at night. In both songs (places)...

It may be seen that the subject carried forward two incorrect ideas, the "whistling of the birds" and the "howling of coyotes", to create another incorrect idea, that of "songs". In spite of the fact that the responses were incorrect, the manner in which memory operated throughout the reading of the message, and probably across units, was evident in this example.

As indicated above, two or more units may be formed which, within themselves, are potentially meaningful, however, they may not be connected one to another in any evident way. This may indicate an inability on the part of the reader to create a single superordinate unit or chunk through the processes of unitizing and recoding which is capable of encompassing all of the cues present in the stimulus. This phenomenon was particularly evident where information created in one unit actually contradicted the information of another unit and thereby made any relationship impossible.

Two examples of contradictory information from two parts of the same

message are presented below.

> Man lives at the surface (bottom) of a sea that is hundreds of miles deep. He lives on the floor of the great ocean of air, the air that surrounds this (our) planet.
>
> The Arctic is far from insects (noiseless). In the summer, the air always is filled with buzzing (the) noise of insects.

In the first example the student apparently did not detect the contradiction between his insertion of the word "surface" and the use of the word "floor" later on, while in the second example the subject completed the first sentence to indicate that there are few insects in the Arctic while the second part indicated that the air is filled with the buzzing of the non-existent insects. In order for a student to detect such contradictions it is necessary that he be able to recall one part of the statement while processing another part. That is, it would appear that he must form at least two units and recode these into one internally consistent unit.

The protocols revealed two additional indications of the possible nature of unitizing in reading comprehension. The first was that it was possible for a subject to form a meaningful unit within the context of units which appear to be meaningless. Several examples are included below.

> The leading ________________(edge) of this great wave of cool air is called ______________(a) cold front.
>
> The fairly warm the (water) of the Gulf Stream that (flows) under the ice of the polar seas.
>
> Strange _____________(as) it seems, up there you and I would not ______________(feel) those very high temperatures.

In each of the above cases it would appear that the subject was able to form a small unit operating over a fraction of the message

while the majority of the message was not well understood. This may indicate that the subject was not able to unitize and comprehend the entire message but was able to form a comprehensible unit for a small part of the message possibly because of the presence of familiar cues. It appeared likely that in cases such as these the subject's comprehension was minimal.

The second indication was that subjects appeared to have difficulty completing a blank on the cloze test where the words already present provided a potentially meaningful unit. Several examples follow.

> ...and drying drying (up) the rivers.
>
> Ask this question of ______________ (most) anyone.
>
> ...it is as though a great ____________ (warm) wave had moved over over (a) region.
>
> The air is indeed an ocean that surrounds the earth (whole) earth.

Very often the blank required the insertion of an adjective or adverb to modify part of the message. It would appear that the fact that the words already present could form a meaningful unit impeded the subjects' ability to include another verbal item in the message.

Units need not necessarily operate within the confines of one or two sentences or even within an entire paragraph. They may, in fact, involve a considerable portion of a passage. The opening section of the article "The North That Never Was" involved the posing of a question, a statement of probable answers and a denial of the accuracy of these responses, three inter-related topics of a single theme. Several subjects committed the following error.

> How wrong are these answers (ideas)...

This error appeared to indicate that subjects were recalling information about the "question" in the preceding paragraph while completing the blank. Thus the two paragraphs may have formed some sort of unit which made evident a relationship among its parts.

The article "The Stonecutter" told a story which was highly cumulative. The stonecutter became first a king, then the sun, a cloud, a rock and finally a stonecutter again. In each case the change in state was motivated by a desire to be "the greatest thing in the world". It may be seen that this type of plot was extremely sequential and cumulative and that it required of the reader that he retain the previous stages in the progression of the stonecutter in order to comprehend the entire sequence. This may place considerable strain upon the memory of the reader as the entire story must be unitized to understand the moral at the end.

This cumulativeness was represented in the cloze test by examples such as the following.

> The stonecutter who was now the rock.
>
> "The cloud is greater than the sun", said the sun (stonecutter) who was now the ruler (sun).

It may be seen that in the first instance the subject was able to recall correctly the present state of the stonecutter while in the second instance the subject appeared confused. Such an inability to recall information correctly would probably impede comprehension of the story since it may destroy the sequence.

While the ability to recognize continuity in language appeared to be essential to comprehension and appeared to involve memory processes, this continuity is not absolute because if it were new topics could not

be introduced. The reader must be prepared to switch topics. However, even the new topic is probably not entirely new but is generally related in some manner to the previous topic or topics. Thus simple recall of previous information is not sufficient. The reader must be prepared to observe potential relationships in the material recalled. The following example indicated this need.

> When we have a short but severe thunderstorm, a cold mass of air has blown in. The leading mass (edge) of this great wave of cool air is called a cold front.

It would appear that this subject relied too heavily on the cumulativeness of language and strict recall in making his response of "mass" when in fact the topic of the discussion had shifted slightly to examine one aspect of the "mass of air", that is, the "edge". It may be that recoding of the units must take into consideration the relation of one topic to another in the discussion.

The comprehension of language messages appeared not only to involve the connection of one verbal item with another to form units but also the creation of higher order bonds between units. This hierarchical unitizing would appear to involve the recoding of information into different and more economical forms for the purposes of retention and of comprehension. It was more difficult to obtain examples which appeared to reveal this process of recoding than it was of the process of unitizing, however, examples were found which appeared to support the concept of recoding.

On occasion the material presented in the cloze tests included a listing of items with a blank requiring the subject to insert an additional item in the list. Several examples are illustrated below.

> ...sheep and dogs (calves), donkeys and horses...

> Many owls, hawks, gulls, eagles (geese), swans, cranes and ducks are found
>
> This water may fall to earth as sleet (rain), hail or snow.

In each of the three cases cited above, the subject supplied an incorrect response. While the response was incorrect, it shared so many features with the other items in the list that it appeared improbable that the response was simply a random guess. Rather, it may be that the subject had gained a concept of the group of items being discussed and supplied a particular exemplar of that group or class which turned out to be an incorrect but plausible response. Thus it would appear that the list of items may have, in some implicit manner, been recoded at a higher level of abstraction to a more generic code (Bruner, 1957). The first example may have involved the class of "domestic animals" the second that of "wild birds" and the last example that of "precipitation".

An additional example appeared to indicate the possibility of recoding quite vividly.

> Almost 120 different kinds of ____________(flowering) plants have been found here (there). They are such common species (plants) as poppies, bluegrass, dandelions, berries (rushes) and mushrooms.

The incorrect response "species" appeared to indicate that the subject had formed a concept of the nature of the list that followed, that of "categories or kinds". This more generic code, formed through the process of recoding, could be more easily retained than the entire list without necessarily losing information which may be crucial to the comprehension of information presented later in the passage.

Another possible form of recoding was indicated in the protocols

of subjects who generally scored lower than average on the cloze tests. The responses of these students indicated that they appeared to complete the blanks of the cloze test almost by straight association to a word or phrase in the immediate vicinity of the blank. This type of response may indicate an inability on the part of the subject to subordinate the parts of a language message to a higher order abstraction, that is, to recode hierarchically. Consequently this may impede comprehension. Several examples appear below.

> ...a sunshade of turquoise <u>blue</u> (silk)...
>
> <u>Every</u> (one) day a shivery feeling <u>cold</u> (went) all through him.
>
> ...breaks <u>noise</u> (the) quiet of the night.
>
> The ocean <u>bottom</u> (of) air is not calm.

In the first example, the response "blue" may have been a close associate of the word "turquoise". Similarly, "cold" may have been a close associate of and triggered off by the phrase "shivery feeling", "noise" may have been an associate of "quiet" and "bottom" of "ocean". If these responses were in fact an indication of the type of recoding that some of the subjects were doing, it may be seen that the resulting code would be inefficient and place great strains on the memory, for the associates were generally at the same level of abstraction as the original code. Consequently, this type of recoding may not facilitate comprehension.

The theoretical discussion in Chapter II put forward the idea that recoding and unitizing were aspects of meaningful memory since they related what is to be retained to the present cognitive structure of the individual. As a result, what is retained is not simply an accurate

record of environmental events but rather a recreation of those events based upon both environmental stimuli and the cognitive structure of the recaller. Specifically, in terms of reading, this may mean that what is present in print is assimilated to what is present in the mind of the reader. This may result in a mis-match of ideas. If so, this mis-match is retained and probably affects the comprehension of the remainder of the passage. The examination of the cloze responses yielded examples which appeared to illustrate this phenomenon.

The article "The North That Never Was" attempted to correct several commonly held misconceptions about the north. The following examples illustrated the attempts of subjects to mold the language in order to match their present beliefs concerning the north.

> __________(In) the Arctic, winters are <u>found</u> (not) so cold as is <u>not</u> believed.
>
> <u>In</u> (For) six weeks the temperature <u>goes</u> (went) up to 90° nearly <u>one</u> (every) day.
>
> There really is <u>a</u> (no) such unpleasant place north <u>of</u> the Arctic Circle.

An additional example from the article "The Air Around Us" not only illustrated the attempt of the subject to impose his ideas upon the printed information but also the inability to detect a contradiction between two parts of the same message.

> Air seems to <u>be</u> very light. It is <u>not</u> (really) very heavy, for the <u>air</u> that surrounds the <u>earth</u> weights 5,000,000,000,000,000 tons...

Thus it would appear that meaningful memory involves the relation of present environmental stimuli to concepts held in the long term store of the processor.

In conclusion, the examination of selected responses to the cloze

tests of reading comprehension appeared to provide illustrations which confirmed the results of the statistical analysis reported previously and to support the theoretical position developed in Chapter II. Memory appeared to play a significant, and at times, crucial role in reading comprehension of printed materials. Memory may provide the psychological counterpart to the cumulativeness of language by means of the twin processes of unitizing and recoding. Through these twin processes the inter-relatedness of the components in a language message are revealed and knowledge of such relationships is a sine qua non of reading comprehension.

III. Summary

This chapter has reported the results of the examination of the profiles of selected individual students and the examination of selected responses to the cloze tests of reading comprehension. The results of these additional forms of analysis appeared to both confirm and elaborate upon the statistical findings reported earlier.

CHAPTER IX

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Reading comprehension is a complex process involving many skills and abilities. Probably because of this complexity, reading educators have lacked sufficient knowledge of the abilities and processes involved in comprehension to design programs of instruction for young readers which are both comprehensive in their scope and relevant in their detail. One of the factors which had received little investigation in relation to reading comprehension is that of memory. The purpose of this study, therefore, was to investigate the nature of the role of memory processes in reading comprehension.

This chapter presents a brief summary of the study together with the findings, conclusions, certain limitations of the investigation, some suggestions for further research and a discussion of the implications arising from the study.

I. Summary of the Study

The study consisted of an investigation of the role of memory in reading comprehension employing three different methods of attack. A review of the available literature concerning reading comprehension and memory processes led to the construction of a theoretical view of the possible role of memory in reading comprehension. Hypotheses were constructed and the investigation was planned based upon this theoretical framework. The data gathered from this investigation were analyzed statistically for indications of the role of memory processes in

reading comprehension. In addition, an examination of selected responses to the cloze tests yielded examples which confirmed and clarified the statistical findings while an examination of selected profiles also confirmed the statistical findings. The results of these latter stages of the investigation were related to the theoretical framework set forth previously.

The theoretical framework established in the first stage of the study adopted a particular position concerning memory processes. This position stressed the role of organization in memory processes and particularly the twin processes of unitizing and recoding as first developed by Miller (1956). The free recall paradigm was used in order to assess the nature of the memory processes of subjects in terms of the organization present.

Free recall lists were constructed by selecting words from reading articles. These same articles were utilized as a basis for the construction of tests of reading comprehension using the cloze procedure. A total of three different reading passages were used.

The free recall lists consisted of twenty-five words each selected from one of the reading articles. Three different types of word lists were selected from each of the articles. The lists were selected according to pre-determined semantic, linguistic and random criteria. Thus a total of nine free recall lists were constructed.

A test of reading comprehension using the cloze procedure was constructed for each of the three reading passages. Every fifth word in each passage was removed and replaced with a standard sized underlined blank.

A total of one-hundred-and-fifty grade six students from a small

urban center were tested for the study. Subjects were required to recall one of the three free recall lists and complete the cloze test for each of the three different reading passages. The type of list recalled was rotated so that each subject received one of each of the three different types of recall lists. Thus each subject received a total of three free recall tasks and three cloze tests. In addition, standardized tests of reading achievement and mental maturity were administered.

The data gathered were processed by a number of statistical techniques including multiple linear regression, analysis of variance, stepwise regression, computation of correlations and Z tests of the variance of proportions. In addition, an examination of selected responses to the cloze tests and of selected individual profiles was undertaken. The findings of these analyses are reported and discussed in the following section.

II. Findings and Conclusions of the Investigation

The study identified some aspects of the role of memory in reading comprehension. These are summarized below according to the null hypotheses, questions, the examination of selected cloze responses and of individual profiles and the additional findings pertinent to the study.

Null Hypotheses

Null Hypothesis 1

There is no significant relationship between performance on a free recall task and the following factors:

i) age
ii) sex,
iii) mental maturity,
iv) reading achievement

Since three different types of free recall tasks and three measures of performance on each task were utilized in this study, the above hypothesis is considered in terms of these additional variables. Statistical analysis indicated that significant relationships existed between performance on the semantic and random free recall tasks, as indicated by the N measure, and the age of the subjects in the total sample. However, the relationship between the N measure for the linguistic free recall task and the age of the subjects in the total sample did not reach the level of significance. Thus the portion of the above hypothesis which pertained to the variable of age was rejected for the semantic and random free recall tasks and accepted for the linguistic free recall task when performance was indicated by the N measure.

There was no significant relationship between performance on the semantic or random free recall tasks, as indicated by the N measure, and the sex of the subjects in the total sample. However, a significant relationship existed between the N measure for the linguistic free recall task and the sex of the subjects in the total sample. Thus, the portion of Null Hypothesis 1 which pertained to the variable of sex was accepted for the semantic and random free recall tasks when performance was indicated by the N measure, and rejected for the linguistic free recall tasks.

Significant relationships existed between performance on the semantic and random free recall tasks, as indicated by the N measure, and the results of the Language sub-section and Total scores, for the total sample on the standardized test of mental maturity. However, the

relationship between the N measure for the semantic and random free recall tasks and the results on the Non-language sub-section of the same test did not reach the level of significance. The relationship between performance on the linguistic free recall tasks, as indicated by the N measure, and the results for the total sample on the test of mental maturity did not reach the level of significance. Thus, with the exception of the Non-language sub-section, the portion of Null Hypothesis 1 which pertained to mental maturity was rejected for the semantic and random free recall tasks and accepted for the linguistic free recall task when performance was indicated by the N measure.

The finding that performance on the semantic and random free recall tasks, as indicated by the N measure, was significantly related to the results of the Language sub-section and Total scores of the standardized test of mental maturity, may have meant that performance on these tasks was based upon some form of verbal intelligence. That is, some ability or abilities which are included in the Language sub-section on the test of mental maturity could underlie performance on the semantic and random free recall tasks, as indicated by the N measure. Since it has been shown that the results of the cloze tests of reading comprehension were also related to the results of the Language sub-section and Total scores of the test of mental maturity, it could be that these same verbal abilities form at least part of the basis of reading comprehension skills as well.

Statistical analysis indicated that significant relationships existed between performance on all three types of free recall tasks, as indicated by the N measure, and the results of the standardized test of reading achievement for the total sample with one exception. The

relationship between the N measure for the linguistic free recall task and the results on the Vocabulary section of the test of reading achievement did not reach the level of significance. With this one exception, the portion of Null Hypothesis 1 which pertained to reading achievement was rejected for all three types of free recall tasks when performance was indicated by the N measure.

The above finding that performance on the free recall tasks, as indicated by the N measure, was significantly related to the results on the standardized test of reading achievement would appear to confirm the earlier results reported by Raymond (1952) and Robeck (1963) and to support the conclusion of Burks and Bruce (1955). However, while the relationship between the results of memory tests and reading comprehension results was incidental to the above quoted studies, it was the central concern of this study.

Statistical analysis indicated that there was no signficant relationship between performance on the semantic and linguistic free recall tasks, as indicated by the R or the RR measure, and either the age or the sex of the subjects in the total sample. Thus the portions of Null Hypothesis 1 which dealt with the variables of age and sex were accepted for both the semantic and the linguistic free recall tasks when performance was indicated by either the R or the RR measure. The random free recall task could not be scored for either of these measures.

Significant relationships existed between performance on the semantic free recall tasks, as indicated by the R measure, and the results of the Language sub-section of the test of mental maturity and the results of the Comprehension section of the reading achievement test for the total sample. None of the other relationships between the R or

RR measures for either the semantic or the linguistic free recall tasks and mental maturity or reading achievement reached the level of significance. Thus, with the above two exceptions noted, the portions of Null Hypothesis 1 which pertained to mental maturity and reading achievement were accepted for both the semantic and linguistic recall tasks when performance was indicated by the R and RR measures. It was interesting that the R measure for the SOL task was significantly related to the results of both the Comprehension section and the Language subsection. This suggested again that the tasks of reading comprehension and the free recall of the SOL word lists may be based upon similar verbal abilities.

Null Hypothesis 2

> There is no significant relationship between performance on a free recall task and reading comprehension as measured by the cloze procedure.

Again since three types of free recall tasks and three measures of performance on these tasks were utilized in the study, the above hypothesis is discussed in terms of these additional variables. Statistical analysis indicated that significant relationships existed between performance on the semantic, linguistic and random free recall tasks, as indicated by the N measure, and the combined cloze scores for the total group. Thus the above hypothesis was rejected for all three types of free recall tasks when performance was indicated by the N measure.

It appeared, therefore, that for the first time a significant relationship had been established between performance on a memory task and the results of measures of reading comprehension. With this relationship in mind, together with the theoretical discussion contained

in Chapter II, it appeared defensible to conclude that memory processes do play a role in reading comprehension.

Both the linguistic and semantic free recall tasks were scored for the R and RR measures. Statistical analysis indicated that a significant relationship existed between performance on the semantic free recall tasks, as indicated by the R measure, and the combined cloze scores for the total group. Furthermore, significant relationships existed between performance on both the semantic and the linguistic free recall tasks, as indicated by knowledge of both the R and RR measures combined, and the combined cloze scores for the total group. However, the relationship between the RR measure for the semantic free recall task and both the R and RR measures alone for the linguistic free recall task and the combined cloze scores for the total group did not reach the level of significance. Consequently, Null Hypothesis 2 was neither unequivocally supported nor denied, when performance was indicated by the R and RR measures, by the available information. This suggested that the measures of performance, the R and RR measures, may be in need of revision.

It was also found that performance on both the semantic and linguistic free recall tasks, as indicated by knowledge of all three measures, that is, N + R + RR, was significantly related to the combined cloze scores for the total sample. Thus Null Hypothesis 2 was rejected for both the semantic and linguistic free recall tasks when performance was indicated by knowledge of all three measures. This finding appeared again to support the conclusion stated earlier that memory processes play a significant role in reading comprehension.

Null Hypothesis 3

> There is no significant difference between the relationship between performance on a free recall task and reading comprehension as measured by the cloze procedure on one of the three types of recall tasks and the similar relationships on the remaining two types of recall tasks.

Statistical analysis using multiple linear regression indicated that the relationship between the measures of performance on the semantic free recall task and the cloze test results for the total sample was generally significant at a higher level than the relationship between the measures of performance on the linguistic and random free recall tasks and the cloze test results. Stepwise regression analysis indicated that the most significant predictor of the variance of the cloze test results for the total sample was the N measure for the semantic task, followed by the N measure for the random free recall task. None of the measures of performance on the linguistic free recall task contributed significantly to the percentage of variance accounted for beyond that predicted by the above two measures. Thus it would appear that the relationship between the performance on the free recall tasks and the cloze test results was strongest for the semantic free recall task, weakest for the linguistic free recall task and that the relationship for the random free recall task fell somewhere in between. Consequently, Null Hypothesis 3 was rejected.

This finding appeared to indicate that in the processing of verbal symbols for comprehension, readers may utilize the semantic cue of conceptual category to facilitate organization in memory processes but did not appear to use the linguistic cue of part-of-speech. Thus knowledge of the redundancy of language, as set forth in Chapter II, would appear

to involve the semantic cue examined but not necessarily the linguistic cue examined. In terms of programs of reading instruction, this finding may indicate one area of instruction for young readers.

Null Hypothesis 4

> There is no significant difference between the relationship between performance on a free recall task and reading comprehension as measured by the cloze procedure on one of the measures of performance of free recall and the similar relationships on the remaining two measures of performance.

In all instances in which the three measures of performance on the free recall tasks, that is, N, R and RR were used as predictors of the cloze test results, the N measure proved to be the best predictor. Furthermore, the N measure was related to the cloze test results at a higher level of significance than the combined R + RR variable. Conseuqently the null hypothesis could not be upheld.

This finding may mean that either for further research purposes or for examination in a reading clinic, the N measure may be the most satisfactory of the three measures of performance used in the study. However, future research on memory processes may reveal superior measures of performance as well as different tasks for assessing memory.

Null Hypothesis 5

> There is no significant difference between the relationship between performance on a free recall task and reading comprehension as measured by the cloze procedure based upon one of the reading articles and the similar relationships based upon the remaining two reading articles.

Since three different reading articles were utilized as a basis for the construction of free recall and cloze tests and since it has been shown that the cloze test based upon Article I was significantly more

difficult than the cloze test based upon Article II, it was decided to investigate the possibility of differences in the relationship between free recall results and cloze test results among the three different articles. In only one instance did the analysis indicate that the relationship was significantly different between two articles. This involved combined Groups III and VI. When Group III was dropped, the difference was no longer significant. Since it has already been shown that Group III differed significantly from the remainder of the sample on the variables of mental maturity and reading achievement which may have been pertinent to this study, it was concluded that the original significant difference was attributable to Group III rather than the article. Consequently, the null hypothesis was accepted.

This finding may not only mean that the results of this study may be generalized to other reading articles but also that the findings may be applicable to passages exhibiting a range of difficulty of comprehension.

Null Hypothesis 6

> There is no significant difference between the relationship between performance on a free recall task and reading comprehension as measured by the cloze procedure for one of the groups and similar relationships for the remainder of the groups.

Statistical analysis indicated that, with three exceptions, the correlations between the free recall results and the cloze test results did not differ significantly from one group to another. All of the exceptions involved abnormally high correlations between the R and RR measures for the semantic free recall task and the cloze test results for Group II. Consequently, with the above exception noted, Null

Hypothesis 6 was accepted.

Questions

Two questions were posed as a basis for exploration. While the main concern of the study was to investigate the possible role of memory in reading comprehension, it was found to be possible to comment as well upon the presence of clustering in the free recall of children aged eleven to thirteen years. Consequently, the following questions were explored.

Question 1

> Do students in the age range from approximately eleven to thirteen years exhibit clustering in the free recall of semantically organized word lists?

The mean R and RR scores for the individual groups and the total sample for the recall of semantically organized word lists approached those reported by Cofer (1965) for the first recall of categorized word lists by university students. Consequently, it was concluded that students in the age range from eleven to thirteen did exhibit clustering in the free recall of semantically organized word lists as defined in this study. This finding appeared to confirm the results of an experiment by Rozov (1964) using grade nine students in Russia. However, no study could be found which examined clustering in the free recall of elementary school children.

Question 2

> Do students in the age range from approximately eleven to thirteen years exhibit clustering in the free recall of linguistically organized word lists?

The mean R and RR scores for the individual groups and the total

sample for the recall of linguistically organized word lists was consistently lower than the same measures for the semantically organized word lists. Furthermore, these values did not approach those quoted by Cofer (1965) for the first recall of word lists organized according to part-of-speech by university students. Therefore, it was concluded that students in the age range from eleven to thirteen did not exhibit clustering in the free recall of word lists organized according to the linguistic criteria of part-of-speech. This finding was similar to that reported by Cofer and Bruce (1964) using adult subjects and contrary to the findings of Stanners (1969) with adult subjects.

Examination of Selected Cloze Responses and Selected Individual Profiles

The results of the examination of selected cloze responses complemented those of the statistical analysis and elaborated upon the role of memory in reading comprehension. Evidence was found among the responses to the cloze tests to support the finding that memory is an integral factor involved in reading comprehension, and further evidence supported the recoding and unitizing concepts as explanations of the manner in which memory operates with written language.

Connected discourse involves the relating of one verbal item with others and memory may play a vital role in establishing this relationship. Comprehension appeared to involve the relating of information presented at different places on a printed page and encountered at different points in time. Memory appeared to be involved in establishing these relationships.

The memory involved, however, did not appear to be a rote memory

but rather a type of memory involving unitizing and recoding. Subjects appeared to form meaningful units from the language message and to recode these units at a higher level of abstraction into informationally richer units. Thus the findings of the examination of selected cloze responses not only complemented the statistical results, but also appeared to support the conclusions of the theoretical discussion of Chapter II and lent support to the model developed as a result of the discussion.

The examination of the individual profiles of selected subjects appeared to indicate that the group findings were generally applicable to the individuals examined. However, strong individual differences were also noted and future research concerning memory process in reading comprehension might profitably focus upon these differences.

Additional Findings Pertinent to the Study

In addition to the results discussed above, a number of other findings emerged as a result of the study. They are reported in this section.

As already indicated, subjects appeared to exhibit clustering in their free recall of semantically organized word lists but not in their free recall of linguistically organized word lists. Furthermore, subjects consistently recalled the greatest number of words from the semantically organized word lists, the smallest number of words from the linguistically organized word lists while the value for the random word lists fell somewhere in between. These two findings appeared to indicate that subjects performed differently on the three types of free recall tasks. Consequently, it was concluded that the three types

of recall tasks were in fact different one from another.

The above finding may have relevance for the understanding of the role of memory in processing language for meaning. It could mean that the subjects responded differently to the cues present for organization in memory processes and would respond similarly on other language tasks. This suggested that the semantic cue of conceptual category facilitated the processing of language while the linguistic cue of part-of-speech did not facilitate the role of memory in language processing. Additional cues could be explored in a similar fashion.

Since it had been shown that the experimental measures of memory and reading comprehension were very often significantly related to the variables of age, sex, mental maturity and reading achievement, it was decided to examine the relationship between performance on the free recall tasks and the cloze test results for the total sample with each of these variables taken into consideration. While the results indicated some minor modifications in the relationship, it was concluded that the relationship between performance on a free recall task and the cloze test results for the total sample was generally unchanged when the factors of age, sex, mental maturity and reading achievement were taken into consideration.

The above finding that the relationship between the results of the cloze tests and performance on the free recall tasks existed when consideration was given to the factors of age, sex, mental maturity and reading achievement may have indicated that memory is an additional factor involved in reading comprehension. Thus the results of this study appeared to provide additional information to what was already

known concerning reading comprehension.

As a result of categorizing the semantically organized word list based upon Article II by a panel of judges, it was found that the words could be categorized according to two different methods. Consequently, the recall protocols based upon this list were scored using this alternate scoring method and the results were used to predict the cloze test results for Groups III and VI. The results of this analysis were then compared to those using the original method of scoring the cloze tasks based upon this list. The results using the alternate method of scoring were comparable to those using the original method of scoring the semantically organized word list for Article II and did not alter the relationship between the free recall results and the cloze test results.

Each group received one delayed recall task based upon Article III. The measures of performance on the delayed recall task were used as predictors of the cloze test results and the findings were compared to the results of a similar analysis using the measures of performance for the immediate free recall of the word lists. The results for the semantic and linguistic free recall tasks for the immediate and delayed recalls appeared to be comparable. However, the relationship between the measures of performance on the delayed random free recall task and the cloze test results appeared to be significant at a higher level than the relationship between the measures of performance on the immediate random free recall tasks and the cloze test results.

This finding indicated the need to explore the relationship between memory and reading comprehension using material which is not pre-organized for the subjects and requiring recall over extended periods of time. The

results of the recall of unorganized lists could be analyzed to discover possible cues for organization in free recall exhibited by the subjects

Statistical analysis indicated that the relationship between the measures of performance on the free recall tasks and the results of the standardized test of memory was not as significant as might be expected of two instruments which purport to measure the same process, that is, memory. The results of the standardized test of memory were significant predictors of both the standardized and experimental reading test results for the total sample. However, caution was advised in interpreting these results due to the heavy emphasis on reading required to complete the standardized test of memory.

Statistical analysis of the relationship between the three measures of performance on the free recall tasks, the N,R and RR measures, indicated that with the exception of the RR measure for the linguistic free recall task, the R and the RR measures alone and in combination were significant predictors of the N measure. This may have indicated that the three measures were examining the same ability or abilities and casted doubt upon the validity of the R and RR measures.

Summary

The results of this study tended to support the concept that memory plays a significant role in reading comprehension. Furthermore, the manner in which memory operates appeared to involve organization in memory processes and particularly recoding and unitizing. These processes appeared to be involved in the relating of information conveyed verbally, an integral aspect of reading comprehension.

III. Limitations of the Applicability of the Findings

In addition to the limitations set forth in Chapter I, the following limitations may restrict the applicability of the findings of the study.

The method of measuring memory employed in this study, that is, the free recall of word lists, represents only one possible memory task and one form of content. While the free recall technique still appeared to be the best method of examining memory for verbal stimulus, the use of word lists may be somewhat artificial since lists differ from connected discourse in ways which have not yet been clearly delineated. Additional forms of stimuli such as phrases, sentences or complete passages may yield additional valuable information.

The measures used to describe performance on the free recall tasks, that is, the N, R and RR measures, did not appear to be independent variables. It may be that all three scores were measuring the same ability of abilities. Different methods of examining performance may prove useful.

The interval between the immediate and the delayed free recall tasks was only four minutes. Larger intervals may yield differing results.

IV. Suggestions for Further Research

As a result of this research project, new areas for additional research have appeared. Some suggestions for further research are indicated below.

The results of this research project need to be confirmed with

different samples. Subjects at different grade levels could be examined to see if the relationship between memory and reading comprehension is evident. It may prove useful to examine subjects at different age levels to see if there is a progression in memory abilities for verbal stimuli, as the work of Piaget and his associates (Piaget, 1968; Inhelder, 1969) seemed to imply, and if there is a similar or complementary progression in the relationship between memory processes and reading comprehension. In addition, samples of subjects from different socio-economic status groups and from large urban and rural areas could be tested to see if the findings hold true for these differing populations.

As stated earlier, the semantic and linguistic free recall lists each exhibited only one basis for organization in memory processes. An examination of additional semantic and linguistic cues for organization may prove valuable. The influence of additional cues such as connectives, punctuation, syntactic structures, semantic features, and vocabulary upon memory processes may necessitate the use of connected discourse as the content for memory. Phrases, clauses, sentences and entire passages could be explored.

Different styles of writing may pose differing reading problems. The relationship between memory processes and reading comprehension could be explored with technical material, literary material and a variety of genres. Furthermore, the cues for organization present in different styles of language may themselves differ. It may prove interesting to attempt to identify the predominant cues in each of a variety of language styles.

As indicated previously, the measures used to assess performance

on the free recall tasks in this study did not prove to be entirely satisfactory. The findings of this study could be explored using different performance measures. These may include measures of subjective organization developed by Tulving (1962) or similar measures set forth by Bousfield, Puff and Cowan (1969). Neither of these methods of assessing performance relies upon a pre-determined basis for organization in memory processes, but tries to assess the degree of organization regardless of the basis of that organization. In addition, however, a thorough qualitative analysis of memory responses may prove enlightening. The development of a classification scheme for the analysis of what students remember and forget after reading an article could prove extremely fruitful.

More needs to be known about the characteristics of readers and their memory processes. Do some readers tend to concentrate on certain types of cues for organization in memory processes? Do some readers tend to recode very abstractly while others tend to remain fairly concrete and specific? Individual differences in the memory processes of readers need to be explored.

Can comprehension be improved by deliberate instruction aimed at developing memory processes for language? Such a question would appear to indicate the ultimate goal for research which focuses upon a better understanding of the processes involved in reading and may have to await further knowledge. However, eventually an attempt will have to be made to apply the knowledge gained concerning the role of memory processes in reading comprehension to the construction of instructional programs and an examination of the results of such instruction. While it is difficult with the limited knowledge available now to visualize such a

program in detail, the crux of instruction may involve rigorous analysis of the semantic and linguistic redundancy present in language and the creation of higher order units through recoding which take advantage of this redundancy. A great deal of further research is required before such a program could be constructed.

V. Implications of the Study

The findings of this research project would appear to have implications for theories of reading comprehension, instructional programs of reading comprehension and teachers of reading

Theories of Reading Comprehension

Valid information must form the basis for curricular and instructional decisions. Consequently, theories of reading, and particulary of reading comprehension, are more than simply intellectual activities. They are directly relevant to the pragmatic needs of young readers in the classroom. It was hoped that this research project has provided information which will facilitate the development of a theory or theories of reading comprehension.

It should be obvious from this research project that any theory of reading comprehension which attempts to be comprehensive must give due consideration to the role that memory plays. Memory processes appeared to play a significant and at times crucial role in reading comprehension. This research project has also reaffirmed the complexity of reading comprehension, a complexity that has been previously recognized by such authors as Huey (1968), Thorndike (1917), Gray (1960) and Russell (1965). Further research must grapple with this complexity

revealing the nature of the processes involved and expand the knowledge base from which long-lasting curricular and instructional decisions can be made.

Instructional Programs of Reading Comprehension

A previous quotation by McCullough (1968) indicated the need for an identification of the subskills required in reading comprehension. Such knowledge is imperative if reading comprehension is to be taught specifically and thoroughly rather than globally and incidentally. Although much remained to be learned about the role of memory in reading comprehension, some implications for instructional programs of reading comprehension emerged from this study.

It would appear as though instructional programs of reading comprehension should attempt to make explicit to the student the systems of redundancy present in written language. However, this task is made difficult by the fact that these systems are as yet poorly defined. Consideration should be given to two broad classes of redundancy, the semantic and the linguistic systems. The field of linguistics is making headway in describing syntactical redundancies, and transformational generative grammar may be relevant to such a search. But the semantic component must never be neglected.

Not only must such systems of redundancy be identified, but the young reader must be taught to utilize this knowldge to improve comprehension. This would appear to involve the processes of unitizing and recoding. Students may be taught strategies for forming meaningful language units containing redundancy and for recoding units into a more generic code. This new code may be more efficient for purposes of

comprehension since it would abstract informationally rich items from the redundancy and thereby reveal the inter-relationship among information presented at different points in the language message.

Much has been said about the cumulativeness of written discourse and the importance of recognizing the inter-relationship among ideas in a message for adequate comprehension. While it may be obvious that language is organized in an horizontal manner running across lines, it would appear that the language message may also be organized vertically in a hierarchical fashion, and this type of organization may be less obvious. Ideas are inter-related at various levels of generality and specificity. Students must be taught to grapple with this more intricate organization present in language if they are to come to grips with the problem of comprehending messages. Only through a thorough grasp of the inter-relationship among information presented can the reader build up a cognitive representation which encompasses all of the ideas contained on the printed page.

A variety of techniques may facilitate the attainment of the above concepts on the part of the reader. Developing the child's understanding of connectives, such as "because" and "although", may improve his understanding of the relationship between information presented in both parts of the message, and thereby facilitate retention and comprehension (Robertson, 1966). Exercises which classify single words or larger units in a manner which relates them one to another may indicate to the child that messages can deal with topics at varying levels of generality and that relationships exist among these levels. For example, simple exercises may require of the reader that he select from a list of words such as "bear, wolf, cow and tiger" those that could be

included under the heading "wild animals". Students should be made to defend their inclusions and exclusions. A slightly more complex exercise may require students to select from a list such as the following "to the store, in the woods, from the country, with great pleasure, over the hill and by the bicycle" those that could be included under the heading "locations". They may then be required to make explicit the differentiation implied by the different prepositions for each of the ones included in the category.

The paraphrasing of spoken dialogue or short excerpts taken from stories or passages would appear to involve recoding and might be useful exercises to improve comprehension. For larger selections, the writing of precis, summaries or outlines may also facilitate recoding of information and thereby improve comprehension. Emphasis in instruction and correction of these activities should focus on the ability of the reader to indicate the relationship among ideas rather than the ability to report information. An excellent source book for outlining has been prepared by Barton (1930).

The reading of material represents only one of the aspects of language usage. Children's writing represents another. Children may be encouraged to analyze their own writing for evidence of cumulativeness. The results could be discussed by the class from the point of view of the potential problems that a reader might encounter in understanding a passage written by a student.

Language messages may be manipulated to alter the relationships among ideas presented with the resulting changes in the meaning emphasized. Irrelevent information can be introduced to exhibit the break in the flow of ideas. Information can be rearranged and the

resulting comprehension difficulties discussed.

Some evidence was cited in the examination of selected cloze responses to show that students occasionally ignored punctuation when responding to the cloze tests. While further evidence is required to make explicit the effects of punctuation upon comprehension, it would appear advisable to focus some attention upon punctuation in instruction of reading comprehension. This could be done by taking the same sentence, punctuating it in several ways, identifying the variety of meaningful units created, and discussing the resulting changes in meaning.

Teacher Education

If changes are to take place in reading instruction as a result of research, the information derived must be communicated to teachers in a form which can be readily understood and applied. This holds true not only for teachers who are currently being trained but also for teachers who are already in the field.

Pre-service education for teachers in training should include some instruction in the teaching of reading. Such instruction should include emphasis upon the processes involved in reading comprehension. This instruction may focus upon these processes through actual concrete situations. The student teachers themselves may be required to undertake tasks utilizing these processes and the results discussed. An additional plan might be to observe young readers under the guidance of trained personnel and to discuss their performance in terms of the processes exhibited.

Practicing teachers are most often brought into contact with newer developments in the field of reading through in-service programs. While

such programs of necessity deal with a variety of topics, some consideration should be given to the processes involved in reading comprehension. Again these ideas should be embodied in concrete situations with which the teachers can identify.

VI. Concluding Statement

This study has shown that memory processes play an integral role in reading comprehension. The nature of memory involvement in reading comprehension appeared to involve the twin processes of unitizing and recoding. Organization in memory processes appeared to take place on the basis of semantic redundancy represented by conceptual categories but not on the basis of the linguistic category of part-of-speech with subjects in the age range from approximately eleven to thirteen years.

In the light of these findings, provision should be made for instruction designed to develop the young reader's ability to unitize and recode. Such instruction would appear to be an integral part of a thorough and comprehensive program of reading comprehension instruction.

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APPENDIX A

INSTRUCTIONS FOR THE ADMINISTRATION OF THE EXPERIMENTAL INSTRUMENTS

INSTRUCTIONS TO STUDENTS

A. Free Recall Test (Regular):

I shall read a list of words to you and I shall also show you the words on the screen. You are to listen to the words and watch the words carefully on the screen, and try to remember as many as you can. After I have read the entire list, I will say "Begin" and you are to write down as many of the words as you can remember in your answer booklets. It doesn't matter what order you remember the words in, but write them down in the order you remember them. It is extremely unlikely that you will be able to remember all the words but try to remember as many as you can. If you are not sure about how to spell a word, write it down the best way you can. Please write the words in a list starting on the left hand side of the page and working towards the bottom of the page.

(Demonstration).

Are there any questions at this time?

Just to review, I will read the words only once and you are to try to remember as many as you can. When I say "Begin", write down all the words you can remember regardless of the order that you remember them in. When I say "Stop", put your pens down.

Are there any questions? I cannot answer any questions once we start.

INSTRUCTIONS TO STUDENTS

B. Cloze Test:

You have been given a passage which has some words missing from it. Each blank with a line under it stands for one word and one word only. You are to try to discover which word is missing from each of the blank spaces and write it in.

(Example to be put on board and worked out)

A strange thing once ______ to some friends who ______ spending a holiday there. ______set out to climb ______ mountain one morning, hoping ______ get a beautiful view ______ blue lakes and snow-capped ______ when they reached the ______.

Sometimes you might find that more than one word could fit into some of the blanks. Always choose the one you think fits best. If you cannot think of the word for one blank, go on to the next and come back to it later. Don't spend too much time on any one blank. It will help you to read the passage through when you have finished to check that the words you have put in all make sense. Some blanks are very hard and no one will be able to get all the words correct, but do the best you can.

All the blanks are the same size, so you cannot tell the size of the word by the size of the blank. Try to spell the words correctly, but if you are not sure of the spelling, do your best to spell it the way it sounds. If you want to change a word, erase it or cross it out neatly. Please try to write neatly.

Are there any questions? Are you ready to begin?

INSTRUCTIONS TO STUDENTS

C. Free Recall Test (Delayed recall):

- comes between first and second paragraphs in the regular instructions:

When I say "Stop", you are to put your pens down immediately and turn to the next page. I shall then ask you to do something else for me, which I think you will enjoy. After we have done that, I shall ask you to turn the page again and you will try to remember as many words as you can from this list again.

D. Filled Association Task: (5 minutes total time)

You should now be on a new page. We are going to do something now which is almost like a game. I am going to say a word and I want you to write down the very first word that comes into your head after I have said my word. Don't be afraid to put down the first word that you think of, as there are no right or wrong answers, it just depends on what word comes into your head first. Please write the words in columns on your page. If you are not sure of the spelling of a word, just spell it the best way you can. Remember, I will only say the word once and you are to write down the first word that comes into your head.

Are there any questions? Are you ready for the first word?

APPENDIX B

CLOZE TESTS OF READING COMPREHENSION

NAME: ______________________

THE NORTH THAT NEVER WAS

"What is the Arctic __________?"

Ask this question of __________ anyone. You will get __________ answer something like this: "__________ Arctic is a land __________ covered with the ice and __________. It's very cold there. __________ is also very quiet, __________ there are few living things."

How wrong are these __________ of great cold, loneliness __________ silence! There really is __________ such unpleasant place north __________ the Arctic Circle.

However, __________, a big island in __________ Arctic, is covered with __________ masses of ice, called __________. On the high mountains __________ are part of Greenland, __________ even summer heat can __________ the snow that falls __________ winter. It piles up __________ forms glacier ice. The __________ flows slowly down to __________ sea where it breaks __________ into great chunks. In __________ past hundred years, fishermen __________ whale and seal have __________ home stories of Greenland's __________. These stories have led __________ persons to believe that __________ northern lands are covered __________ ice.

"Surely the Arctic __________ covered with deep snow," __________ persons say. But many __________ in the Far North __________ less snowfall than Chicago. __________ winds sweep most of __________ snow that falls in __________ Arctic into deep cracks __________ the earth. The wind __________ up the snow on __________ protected sides of hills. __________ arctic land is free __________ snow.

How true is __________ idea that the Arctic __________ very cold weather all __________ long? Herschel Island is __________ 200 miles beyond

NAME: ____________________

the __________ Circle. The lowest temperature __________ has been 54° below __________. That is cold. But __________ winters are found in __________ places south of the __________.

One of these places __________ Dawson, a city in __________ Canada, several hundred miles __________ of Herschel Island. In __________ the thermometer sometimes drops __________ 65° below zero. Yet __________ is an ordinary town __________ people live all the __________ round. Another cold place __________ Yellowstone National Park, where __________ thermometer has shown as __________ as 66° below zero.

__________ seems strange that winters __________ are colder as you __________ south from the Arctic. __________ the Arctic, winters are __________ so cold as is __________ believed. The fairly warm __________ of the Gulf Stream __________ under the ice of __________ polar seas. This warm __________ acts like a great __________. By giving off a __________ heat, it keeps the __________ from becoming too cold.

__________ northern part of Iceland __________ within the Arctic Circle. __________ to the Gulf Stream, __________ has mild weather. Some __________ at places where the __________ is no higher than __________ ocean level, the temperature __________ falls to zero. Nearness __________ water helps to make __________ winters mild.

We do __________ think of the North __________ having summer heat. However, __________ does have hot days. __________ Yukon in Alaska is __________ miles north of the __________ Circle. Every summer the __________ in the shade goes __________ to 90°.

Once I __________ a summer 75 miles __________ of the Arctic Circle. __________ six weeks the temperature __________ up to 90° nearly __________ day. It did not __________ cool at night, because __________

NAME: ____________________

sun does not set. __________ my party said that __________ suffered more from heat __________ summer than we ever __________ suffered from cold.

The __________ land of the North __________ not without living things. __________ 120 different kinds of __________ plants have been found __________. They are such common __________ as poppies, bluegrass, dandelions, __________ and mushrooms.

The grassy __________ of the Arctic have __________ of herds of reindeer, __________ caribou as they are __________ in Alaska. On the __________ prairies are thousands of __________ and polar foxes, both __________ and blue. Most of __________ animals stay north all __________ Many owls, hawks, gulls, __________, swans, cranes and ducks __________ found. The Arctic Sea __________ as much life in __________ as any other sea.

__________ Arctic is far from __________. In the summer, the __________ always is filled with __________ noise of insects. Bluebottle __________ hum and mosquitoes buzz. __________ cries of shore birds, __________ as snipe and sandpipers, __________ be heard. The squawking __________ ducks and the cackling __________ geese also are heard. __________ scream of a large __________ bird, the loon, breaks __________ quiet of the night.

__________ have heard the same __________ on the treeless plains __________ Dakota and in the __________ regions. I have listened __________ the whistling of the __________ and the howling of __________ at night. In both __________ I have heard the __________ crack with the frost __________ winter. The sound is __________ that of a rifle __________ off. In the Far __________, the ice piles against __________ cold shores.

NAME: ____________________

One cake __________ over another with a __________, frightening screech. Then the __________ snaps and cracks. One __________ a groaning and a __________. It sounds like cannon __________.

We of the Far __________ never forget the boom __________ screech and roar of __________ ice pack. In books, __________ reads about the bare, __________, silent North. The real __________ is full of life __________ sound.

NAME: ____________________

THE STONECUTTER

Once upon a time __________ was a stonecutter who __________ hard all day long, __________ stones with hammer and __________. These he made into __________ for building houses and __________. It was hard work, __________ the sonecutter was happy __________ one day when he __________ the king ride by.

__________ king was sitting in __________ fine carriage, and servants __________ a sunshade of turquoise __________ with golden tassels over __________.

"Oh," breathed the stonecutter, "__________ only I were the __________, and servants held a __________ over me!"

Now inside __________ mountain, where the stonecutter __________ working, lived an old __________ who heard his wish __________ gave it to him.

__________ the next minute the __________ was himself the king. __________ was sitting comfortably in __________ carriage. Servants were holding __________ his head the turquoise __________ with the golden tassels.

"__________," he breathed happily. "Now __________ am the greatest of __________ people alive. I am __________ king. I shall wear __________ crown. I shall sit __________ a throne in a __________."

One day when he __________ about to go for __________ ride the servants forgot __________ sunshade, and the king __________ to wait in his __________ until they brought it. __________ sun shone down extremely __________ and hot. He was __________ uncomfortable.

"I am not, __________ all, the greatest thing __________ the world," he said __________ envy. "The sun is __________ enough to make me

NAME: __________

__________. He is greater than __________. Oh, how I wish __________ were the sun!"

Again __________ old wizard in the __________ gave him his wish. __________ stonecutter became the sun. __________ shone down over the __________, with all his strength, __________ the grasses and drying __________ the rivers. The people __________ from the fierce beams __________ this burning sun.

One __________ a cloud drifted between __________ and the earth, and __________ could not shine through __________.

"The cloud is greater __________ the sun," said the __________, who was now the __________. "Oh, if only I __________ be that cloud!"

The __________ wizard in the mountain __________ his wish, and he __________ once became the cloud. __________ he had the power __________ send down water upon __________ earth. This he did __________ such might that soon __________ river rushed in a __________ torrent over its banks, __________ with it sheep and __________, donkeys and horses, and __________ putting people to flight __________ his great power.

One __________ the water could not __________. That one thing was __________ great rock which stood __________, and the water had __________ go around it.

"What!" __________ the stonecutter, who was __________ the cloud, "Is there __________ more powerful than I? __________, if only I could __________ that rock!"

In the __________ second the stonecutter became __________ rock. He held himself __________ and looked far down __________ the people moving below __________. Rain could not wash __________ away, and he was __________ longer discontented.

"Now I __________ no one," he said, "__________ can watch the days __________ years come and go."

NAME: ____________________

__________ day a shivery feeling __________ all through him. A __________ was hitting the rock __________ hammer and chisel, and __________ of the rock were __________ broken off and falling __________ upon the ground.

The __________, who was now the __________, said, "Is there something __________ powerful than the rock? __________, if only I could __________ that man!"

At once __________ stonecutter became that man __________ found himself where he __________ been at the beginning, __________ the rock with hammer __________ chisel.

"There is nothing __________ than man and the __________ he is best able __________ do." said the stonecutter __________. Once again he was __________.

NAME:__________________

THE AIR AROUND US

Man lives at the __________ of a sea that __________ hundreds of miles deep. __________ lives on the floor __________ the great ocean of __________, the air that surrounds __________ planet.

No plant or __________ can live without air. __________ would be no weather __________ air; no winds, clouds __________ rain. There would be __________ bright blue sky and __________ flaming red sunsets. There __________ be no fire, for __________ occurs only if oxygen __________ present. Without air there __________ not be sound, for __________ is air that carries __________ to our ears.

Air __________ us from sunlight. The part of sunlight which gives __________ sunburn is so strong __________ it could destroy us. __________ this part is weakened __________ going through the air.

__________ protects us both from __________ and from cold. At __________ the air traps the __________ of day, keeping it __________ going off into space. __________ there were no air, __________ temperature at night would __________ to 300 degrees below __________. In the daytime, the __________ would rise to 230 __________ above zero.

Air is __________ of many different gases. __________ of the air is __________, a gas that our __________ do not use directly. __________ large part of the __________ is oxygen. We could __________ stay alive without this __________ to breathe. No living __________ either plant or animal, __________ live without oxygen. Sometimes __________ is called "the gas __________ life."

Air seems to __________ very light. It is __________ very heavy, for the __________ that surrounds the earth __________ 5,000,000,000,000,000 tons (five million, __________ tons). We do not __________ this weight

NAME: ____________________

because the __________ surrounds us completely. It __________ both inside and outside __________.

The lower part of __________ air ocean is warmed __________ touching the warm earth. __________, as we go away __________ the earth, we find __________ the temperature is lower.

__________ the air does not __________ steadily colder very high __________ the earth. In the __________ of air from ten __________ to 40 or 50 __________ above the earth, the __________ is about 67 degrees __________ zero. It is that __________ all the time, night __________ day, winter and summer.

__________ we go out still __________ from the earth, the __________ rises again. Far out, __________ temperature rise steadily, reaching __________ 4000 degrees at an __________ of 250 miles.

Strange __________ it seems, up there __________ and I would not __________ these very high termperatures. __________ on earth we feel __________ because billions of air __________ strike us. The faster __________ particles are moving, and __________ more particles there are, __________ warmer we feel. But above 50 miles the air __________ very thin. There are __________ enough air particles for __________ to feel them as __________ strike us.

The ocean __________ air is not calm. __________ is a tossing sea __________ great waves. These waves __________ air cause changes in __________ weather. The ocean of __________ is always changing, and __________ weather is always changing.

__________ is simply air in __________. The heat of the __________ and the spinning of __________ earth cause the winds __________ blow as they do. __________ winds usually blow from __________ cool place to a __________ region.

NAME: __________

When we have __________ short but severe thunderstorm, __________ cold mass of air __________ blown in. The leading __________ of this great wave __________ cool air is call __________ cold front. The storm __________ most often be followed __________ clear, pleasant weather.

When __________ air blows in, it __________ as though a great __________ wave had moved over __________ region. The leading edge __________ called a warm front. __________ brings cloudy, rainy weather __________ may last two or __________ days, sometimes longer.

All __________ are made of water __________. The droplets are so __________ that a teaspoon could __________ five billion of them!

__________ there are many droplets, __________ sky is covered with __________. As they cool, the __________ come together to make __________ of water. This water __________ fall to earth as __________, hail or snow.

Look __________ you on a hot __________ afternoon. You may see __________ clouds all at about __________ same height above the __________. At that height, the __________ is cold enough for __________ to form.

The blue __________ and the white clouds, __________ sunset, rainbows, the flash __________ lightning - all are beautiful. __________ air we would see __________ of them.

Air scatters __________. Near the earth, where __________ air is dense, sunlight __________ scattered rather completely, making __________ sky look blue. But __________ sky looks blue only __________ to about 12 miles __________ earth. Beyond, it darkens __________ deep purple because the __________ is less dense. Above __________ miles, the air is __________ thin. Here the sky __________ no color at all. __________ is completely black.

We __________ see the air, but __________ can see beauty in __________. We cannot feel the __________, yet it weighs billions __________

NAME: ____________________

tons. We usually do __________ even think much about __________ air, yet we could __________live five minutes if __________ were no air to __________.

The air is indeed __________ ocean that surrounds the __________ earth. And you and __________ live at the bottom __________ this great sea of __________.

APPENDIX C

FREE RECALL LISTS

RECALL LISTS RANDOMLY ARRANGED

Article I: The Stonecutter:

SOL	LOL	ROL
BLOCKS	TURQUOISE	MADE
BURNING	AND	WORK
PROUDLY	WATER	PEOPLE
COMFORTABLY	NEXT	WAS
WIZARD	MINUTE	HIS
ROCKS	OVER	ONCE
DISCONTENTED	SHIVERY	BEEN
HAMMER	OLD	ABOUT
GOLDEN	SILK	FINE
CROWN	WHO	SAID
CARRIAGE	HOUSES	PUTTING
ENVY	WILD	RIDE
CHISEL	HARD	WITH
CASTLE	LONG	POWERFUL
STONES	SOON	FAST
BEAMS	WHEN	GREATEST
THRONE	BREATHED	CRIED
MAN	EXTREMELY	SAW
PEOPLE	IF	THE
SERVANT	DONKEY	WHO
STONECUTTER	THAT	BROUGHT
SHONE	WORKED	DAY
FIERCE	DRYING	CLOUD
SUN	HELD	SAID

RECALL LISTS RANDOMLY ARRANGED

Article II: The North That Never Was:

SOL	LOL	ROL
PRAIRIES	RIFLE	FAR
FOXES	NIGHT	GULF
WOLVES	LESS	FISHERMAN
PLAINS	ASK	ANIMALS
MOUNTAINS	FAIRLY	THEN
WINTER	ALWAYS	OFF
SNAPS	EARTH	MUSHROOM
BOOMING	SLOWLY	OFTEN
COLD	FORGET	THERE
PLANTS	PERSONS	WEEKS
SNOW	OFTEN	MOST
FLOWERING	SWEEP	LARGE
ISLAND	NORTHERN	PART
GLACIERS	FILLED	RADIATOR
OWLS	DEEP	WEATHER
ICE	YET	THE
REINDEER	BREAKS	HUNDRED
HILLS	HOWEVER	GREAT
HOWLING	BUT	SOME
RUSHES	LOWEST	PLACES
WHISTLING	THAT	MASSES
DANDELIONS	GREAT	ARE
SCREECH	CIRCLE	PACK
GRASSY	USUALLY	THAT
CARIBOU	WHERE	HELPS

RECALL LISTS RANDOMLY ARRANGED

Article III: The Air Around Us:

SOL	LOL	ROL
RAIN	WHICH	SCATTERS
WAVES	STEADILY	IS
COLDER	TOUCHING	COULD
CALM	LIVES	ALL
THUNDERSTORM	OUR	FROM
SEA	ANIMAL	MUCH
WINDS	HIGH	COVERED
LIGHT	BOTTOM	DAY
SUMMER	FLAMING	BURNING
WEIGHS	WHEN	KEEPING
TONS	DIFFERENT	DEEP
OCEAN	PLANET	COLD
LIGHTENING	FEEL	WE
HEAVY	YET	TEMPERATURE
OXYGEN	ONLY	RED
WINTER	SOUND	SUNSET
AIR	OFF	NIGHT
CLOUDS	BLUE	STILL
WARMED	VERY	BOTH
TOSSING	PROTECTS	AIR
GASES	WHERE	AND
TEMPERATURE	SUNBURN	RISE
BREATHE	BUT	MOVING
NITROGEN	SURROUNDS	NO
BILLIONS	USUALLY	DENSE

RECALL LISTS ARRANGED IN CATEGORIES

Article I: The Stonecutter

Semantically Organized List:

stones	stonecutter	crown	sun	happy
chisel	servant	throne	beams	comfortable
blocks	wizard	castle	shone	envy
rocks	man	carriage	fierce	proudly
hammer	people	golden	burning	discontented

Linguistically Organized List:

houses	worked	turquoise	hard	who
silk	held	old	long	when
minute	breathed	wild	over	and
water	forgot	shivery	extremely	that
donkey	drying	next	soon	if

Randomly Organized List:

ride	day	work	said	cloud
thing	fine	about	once	who
made	the	putting	powerful	cried
greatest	brought	been	people	fast
saw	was	with	nothing	his

RECALL LISTS ARRANGED IN CATEGORIES

Article II; The North That Never Was

Semantically Organized List:

plants	ice	reindeer	screech	mountains
flowering	snow	caribou	howling	plains
grassy	glaciers	wolves	whistling	prairies
rushes	cold	foxes	booming	island
dandelions	winter	owls	snaps	hills

Linguistically Organized List:

persons	ask	lowest	always	where
night	sweep	northern	slowly	however
rifle	filled	great	often	that
earth	forget	deep	usually	but
circle	breaks	less	fairly	yet

Randomly Organized List:

there	hundred	off	weather	mushrooms
masses	that	far	are	helps
great	places	then	weeks	gulf
part	some	the	animals	often
most	fishermen	pack	radiator	large

RECALL LISTS ARRANGED IN CATEGORIES

Article III: The Air Around Us

Semantically Organized List:

winds	sea	warmed	air	light
clouds	waves	winter	gases	weighs
rain	ocean	summer	nitrogen	tons
thunder-storm	tossing	colder	oxygen	heavy
lightening	calm	temperature	breathe	billions

Linguistically Organized List:

animal	feel	blue	only	which
sound	lives	our	off	when
planet	surrounds	different	very	where
bottom	protects	high	steadily	yet
sunburn	touching	flaming	usually	but

Randomly Organized List:

night	moving	still	could	air
deep	both	dense	we	rise
is	and	sunset	day	no
burning	temperature	much	keeping	covered
from	cold	scatters	red	all

APPENDIX D

FILLED ASSOCIATION TASK

Filled Association Task:

child	baby	shoes	justice	fruit
butterfly	bread	king	scissors	cry
bath	cheese	guns	always	cabbage
foot	fingers	eating	bed	beautiful
head	hammer	chair	carpet	afraid
needle	man	blossom	doctor	hungry
table	soldier	anger	girl	priest

APPENDIX E

SUMMARY OF CATEGORICAL ERRORS

SUMMARY OF CATEGORICAL ERRORS

A categorical error in the free recall of a word list has been defined by Bousfield (1953) as an incorrect response which could be included in at least one of the categories present in the stimulus list. Included below is the list of all errors considered to be categorical which subjects included in their free recall of the SOL lists based upon each of the three articles. The bracketed number following the words indicates the frequency of occurrence of the particular error, if the error occurred more than once.

Article I: The North That Never Was

icecap	peaks	geese
region	places	clicked
coyote (3)		

Article II; The Stonecutter

king (2)	shining	conceated
building	mean	happiness
palace (2)		

Article III: The Air Around Us

a) Immediate Free Recall

wet (2)	droplets	whales
weather(3)	thunder (2)	hot
water (3)	hydrogen (4)	cooler
storm (9)		

b) Delayed Free Recall

water (6)	coast	droplets
thunder(3)	thermometer	atmosphere
storm (7)	wet	heat
hydrogen (7)	shore	rainbows
weather(6)		

APPENDIX F

ADDITIONAL STATISTICAL TABLES

TABLE

NEWMAN-KEULS COMPARISON BETWEEN ORDERED MEANS ON SELECTED VARIABLES

			Table of Newman-Keuls Comparison Between Ordered Means					
Variable	Multiplier	Means	3	2	6	1	5	4
Age	1.24343		140.680	140.280	139.880	139.160	138.840	138.520
		4 138.520	2.160	1.760	1.360	0.640	0.320	0.0
		5 138.840	1.840	1.440	1.040	0.320	0.0	
		1 139.160	1.520	1.120	0.720	0.0		
		6 139.880	0.800	0.400	0.0			
		2 140.280	0.400	0.0				
		3 140.680	0.0					
			5	6	4	2	1	3
Vocab.	1.63871		38.880	37.720	36.000	35.760	35.040	34.000
		3 34.000	4.880	3.720	2.000	1.760	1.040	0.0
		1 35.040	3.840	2.680	0.960	0.720	0.0	
		2 35.760	3.120	1.960	0.240	0.0		
		4 36.000	2.880	1.720	0.0			
		6 37.720	1.160	0.0				
		5 38.880	0.0					
			5	1	2	6	4	3
Comp.	1.63293		42.960	41.960	41.120	40.880	40.040	38.040
		3 38.040	4.920	3.920	3.080	2.840	2.000	0.0
		4 40.040	2.920	1.920	1.080	0.840	0.0	
		6 40.880	2.080	1.080	0.240	0.0		
		2 41.120	1.840	0.840	0.0			
		1 41.960	1.000	0.0				
		5 42.960	0.0					
			5	3	1	4	6	2
Non-Lang.	1.40761		43.600	42.000	41.840	41.200	40.840	40.440
		2 40.440	3.160	1.560	1.400	0.760	0.400	0.0
		6 40.840	2.760	1.160	1.000	0.360	0.0	
		4 41.200	2.400	0.800	0.640	0.0		
		1 41.840	1.760	0.160	0.0			
		3 42.000	1.600	0.0				
		5 43.600	0.0					

TABLE (Continued)

		Table of Newman-Keuls Comparison Between Ordered Means						
Variable	Multiplier	Means	1	5	6	2	4	3
Lang.	1.85407		45.400	44.320	42.640	41.360	40.560	38.000
		3 38.000	7.400	6.320	4.640	3.360	2.560	0.0
		4 40.560	4.840	3.760	2.080	0.800	0.0	
		2 41.360	4.040	2.960	1.280	0.0		
		6 42.640	2.760	1.680	0.0			
		5 44.320	1.080	0.0				
		1 45.400	0.0					
			5	1	6	2	4	3
Cal. Total	2.68877		88.400	85.360	83.080	81.800	81.760	80.000
		2 80.000	8.400	5.360	3.080	1.800	1.760	0.0
		4 81.760	6.640	3.600	1.320	0.040	0.0	
		2 81.800	6.600	3.560	1.280	0.0		
		6 83.080	5.320	2.280	0.0			
		1 85.360	3.040	0.0				
		5 88.400	0.0					
			2	1	6	5	4	3
Cloze I	3.53702		56.560	55.080	51.560	51.400	51.280	49.240
		3 49.240	7.320	5.840	2.320	2.160	2.040	0.0
		4 51.280	5.280	3.800	0.280	0.120	0.0	
		5 51.400	5.160	3.680	0.160	0.0		
		6 51.560	5.000	3.520	0.0			
		1 55.080	1.480	0.0				
		2 56.560	0.0					
			1	5	2	6	3	4
Cloze II	3.71257		67.960	67.640	65.920	64.120	63.440	59.600
		4 59.600	8.360	8.040	6.320	4.520	3.840	0.0
		3 63.440	4.520	4.200	2.480	0.680	0.0	
		6 64.120	3.840	3.520	1.800	0.0		
		2 65.920	2.040	1.720	0.0			
		5 67.640	0.320	0.0				
		1 67.960	0.0					

TABLE (Continued)

			Table of Newman-Keuls Comparison Between Ordered Means					
Variable	Multiplier	Means	5	6	2	1	4	3
Cloze III	4.61560		81.560	76.960	75.080	74.960	73.440	64.840
		3 64.840	16.720	12.120	10.240	10.120	8.600	0.0
		4 73.440	8.120	3.520	1.640	1.520	0.0	
		1 74.960	6.600	2.000	0.120	0.0		
		2 75.080	6.480	1.880	0.0			
		6 76.960	4.600	0.0				
		5 81.560	0.0					

** $p < .01$
* $p < .05$

TABLE

ANALYSIS OF VARIANCE : GROUP III COMPARED WITH REMAINDER OF SAMPLE

Variable	Source	SS	MS	DF	F	p
Age						
	Groups	0.3700	37.00	1.	0.97	0.32516
	Error	0.5619	37.97	148.		
Speed and Accuracy	Groups	0.1555	15.55	1.	0.41	0.52261
	Error	0.5604	37.86	148.		
Vocabulary						
	Groups	0.1497	149.60	1.	2.23	0.13712
	Error	0.9915	66.99	148.		
Non-Language	Groups	0.3563	3.56	1.	0.07	0.78831
	Error	0.7286	49.23	148.		
Total : California	Groups	0.3468	346.81	1.	1.91	0.16866
	Error	0.2682	181.24	148.		
Cloze I						
	Groups	0.3228	322.75	1.	1.05	0.30801
	Error	0.4565	308.44	148.		
Cloze II						
	Groups	0.5381	53.81	1.	0.16	0.69267
	Error	0.5078	343.12	148.		

** $p < .01$
* $p < .05$